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THE PHYSIOGRAPHY OF SOUTH-CENTRAL ONTARIO

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The agriculture of any country is dependent upon the fundamental factors which find expression in its climate and its soils. The soils themselves are in a broad sense dependent upon climate, but within any stated climatic zone the characteristics of the soils are in the main determined by the nature of the geologic material and the attendant drainage phenomena. The depth and texture of the deposits together with the topography of the exposed surface are important, for under Ontario conditions the downward moving water is the most active agent of weathering.

The region which has recently been under investigation by the agriculturists of the Ontario Research Foundation is that portion of old Ontario lying to the east of the Niagara Escarpment and north of Lake Ontario. The northern boundary is formed by Georgian Bay and by the rocks of the Precambrian Shield which extend in a line from Georgian Bay to the shore of Lake Ontario near the city of Kingston. Roughly triangular in shape, this region has an area of slightly more than 8,000 square miles.

Ontario lies well within the zone which was covered by ice during the Glacial Period; hence nearly all of the surface deposits in the region under discussion owe their form, structure and position either to the action of the ice itself or to that of the waters of the glacial streams and lakes which existed during the retreat of the continental glacier. While many observations have been made which will be of value in piecing together the glacial history of the region and in correlating it with similar work in the adjoining states, it is not our purpose to enumerate them here, but rather to describe in general terms the deposits which constitute the parent materials upon which the soils have been developed.

THE UNDERLYING ROCKS

The importance of the underlying rock formation consists chiefly in its influence upon the materials composing the surface drift. In a comparatively small area, the surface of the bed rock is exposed to become the dominant physiographic feature; elsewhere it is deeply buried by drift deposits. It has been shown by geologists in many localities that the greater part of the material in glacial drift is derived from local sources and has been transported for relatively short distances. Alden (*1*) in Wisconsin reports over 90% local limestones in the drift with less than 10% of Canadian crystalline rocks. Our own observations have shown that while the drift may contain many erratics from the distant Precambrian

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rocks, most of the drift material has been derived from the underlying Paleozoic formations and has been transported but a few miles. The relative areas and stratigraphic sequence of these rocks are illustrated in Figure 1. Of chief interest is the fact that east of a line drawn from Collingwood to Oshawa, the underlying rocks are calcitic limestones of the Trenton and Black River series, while the area to the west is based upon the Utica, Lorraine and Queenston shales.

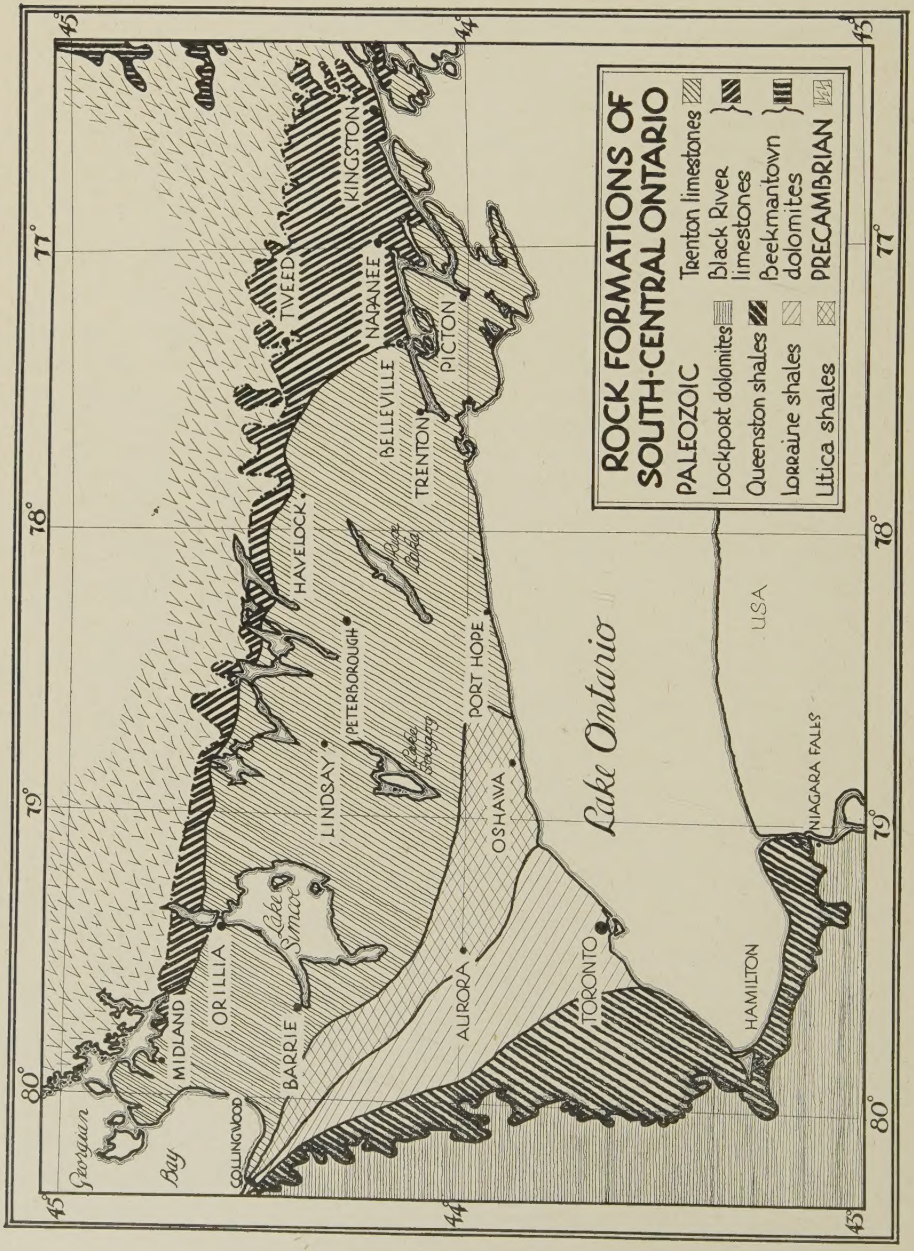

FIGURE 1. Map of South-central Ontario showing approximate boundaries of the underlying rock formations. (Adapted from Canada Department of Mines Bulletin 682.)

RETREAT OF THE GLACIER

The retreating edge of the last continental ice sheet assumed a lobate form and the movement of the ice in the lobes was largely controlled by the underlying topography. After the disappearances of the ice from Southwestern Ontario, Southcentral Ontario was occupied by two lobes, both of which flowed toward the southwest as shown in Figure 2. The northern of these two lobes occupied the region of the Trent Valley, Lake Simcoe and Georgian Bay, while the other filled the basin of Lake Ontario. The elevated and hilly region between them, which has been described

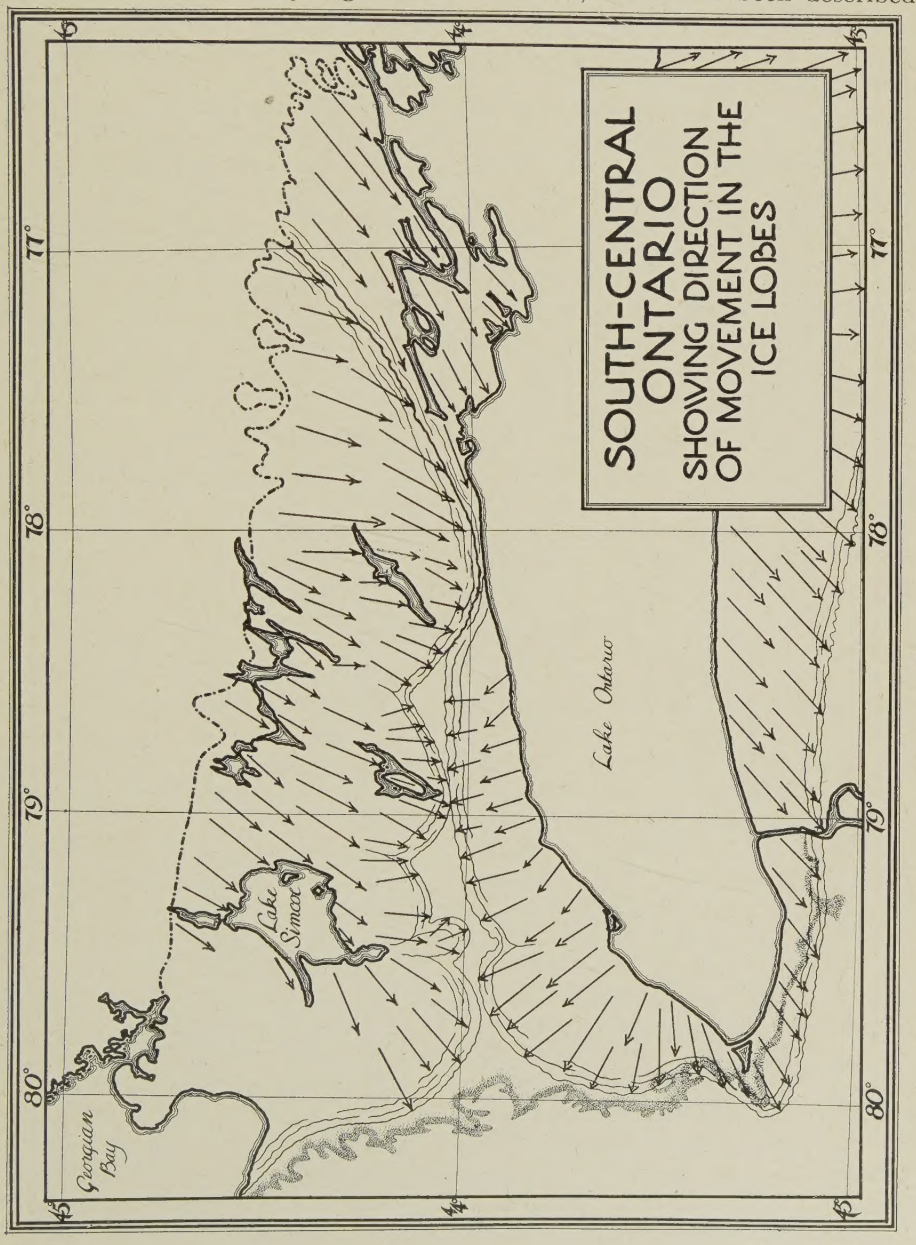

FIGURE 2. Map of South-central Ontario showing the direction of movement in the ice lobes as indicated by drumlins and other forms of glacial deposits.

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by Taylor (*10*) as the Oak Ridges Moraine, is an interlobate area containing deposits of an exceedingly varied character much of which consists of sands and gravels laid down by torrential meltwaters.

There is evidence to show that the melting of the two lobes did not proceed at a uniform rate. It is probable that the Ontario basin contained "live" ice for some time after the northern lobe had become stagnant. Taylor (*10*) has described several moraines which mark the ice front during various stages of the recession of the Ontario lobe, whereas such formations are not known for the northern lobe, the deposits of which consist chiefly of rather haphazard ground moraine. It is also known that there was open water to the north at a time when the ice of the Ontario lobe was still pressing against the moraine.

During the recession of both lobes a series of ice-dammed lakes was held up between the ice front and the higher land. In the later stages of the retreat the deeper portions of both the Ontario and the Georgian Bay basins were occupied by the forerunners of the present Great Lakes. The body of water to the north has been called Lake Algonquin while that which occupied the Ontario basin is known as Lake Iroquois. The strong development of shore features shows that both of these lakes led long and active lives and their deposits are of great interest. Finally the ice left the St. Lawrence valley, and the Ontario basin became for a time an arm of the Champlain Sea until the rising of the land toward the north shut out the salt water.

NATURE OF THE SURFACE DEPOSITS

In the deep waters of Lake Algonquin, Lake Iroquois and other smaller glacial lakes, vast quantities of "varved" clays and silts were deposited. The word "varve" is of Swedish origin and signifies an annual layer. Recently Antevs (*2*) has published a study of the varved clays of eastern North America and attempted to compute thereby the length of time required for the recession of the last ice sheet. The formation of varves is due to the fact that in the glacial lakes the coarser sediments were laid down during the summer while the finer particles of clay remained in suspension and settled out during the winter when no fresh material was being carried into the lake. Thus it is that clay deposits may be seen to be made up of fine and coarse layers, each pair of which constitutes a varve. In many cases the clays are covered by deposits of loam and fine sand laid down as the waters were receding.

Much of the surface uncovered by the retreating ice was above the level of the marginal lakes, and the unmodified glacial drift was deposited as ground moraine. Recessional moraines were formed in some places where the ice front halted for a time or pressed forward in a slight readvance.

There are also large areas which, although submerged for a time by lake waters, have not been modified to any great extent; the morainic deposits have retained their original form with little or no clay or sand being deposited over them. In the eastern end of the region there are extensive areas in which the limestone rock is usually within a few inches of the surface. This area was covered by the waters of Lake Iroquois and by succeeding marine waters but only in the lower places are there any appreciable clay deposits. These clays are nearly all marine and not varved. A similar area of exposed limestone is found in the Algonquin lake bed in Carden Township to the northeast of Lake Simcoe.

PHYSIOGRAPHIC DIVISIONS

In such a complicated area, it is difficult to be definite in drawing minor physiographic boundaries; nevertheless, in certain areas there is to be found a degree of uniformity which merits consideration. From a comparison of various factors, including altitude, topography and the nature and origin of the surficial deposits, the ten divisions shown in Figure 3 have been outlined. In the following paragraphs the chief features of each of these divisions will be briefly described.

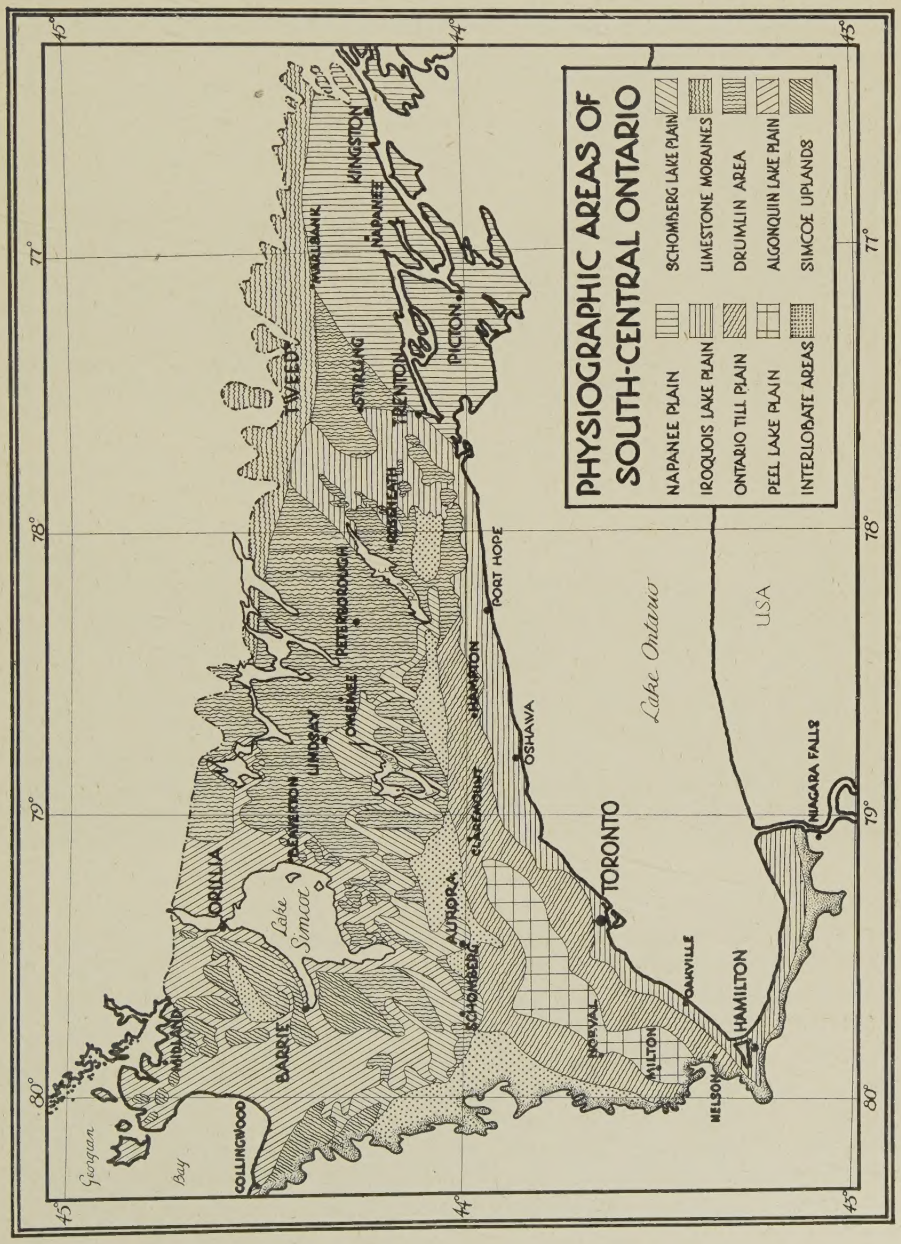

FIGURE 3. Map of South-central Ontario showing the physiographic divisions based upon the nature and origin of the surface deposits.

I. The Napanee Plain

This is the most easterly division under discussion and comprises an area of about 1,200 square miles in Prince Edward, Hastings, Lennox and Addington, and Frontenac counties. It takes its name from the town of Napanee which is approximately its geographic centre. Wilson (*13*) has given a very good description of the physical features of this region. It has low relief, the surface of the underlying limestone sloping gently from an altitude of 600 feet at the cuesta, to 245 feet above sea level at the

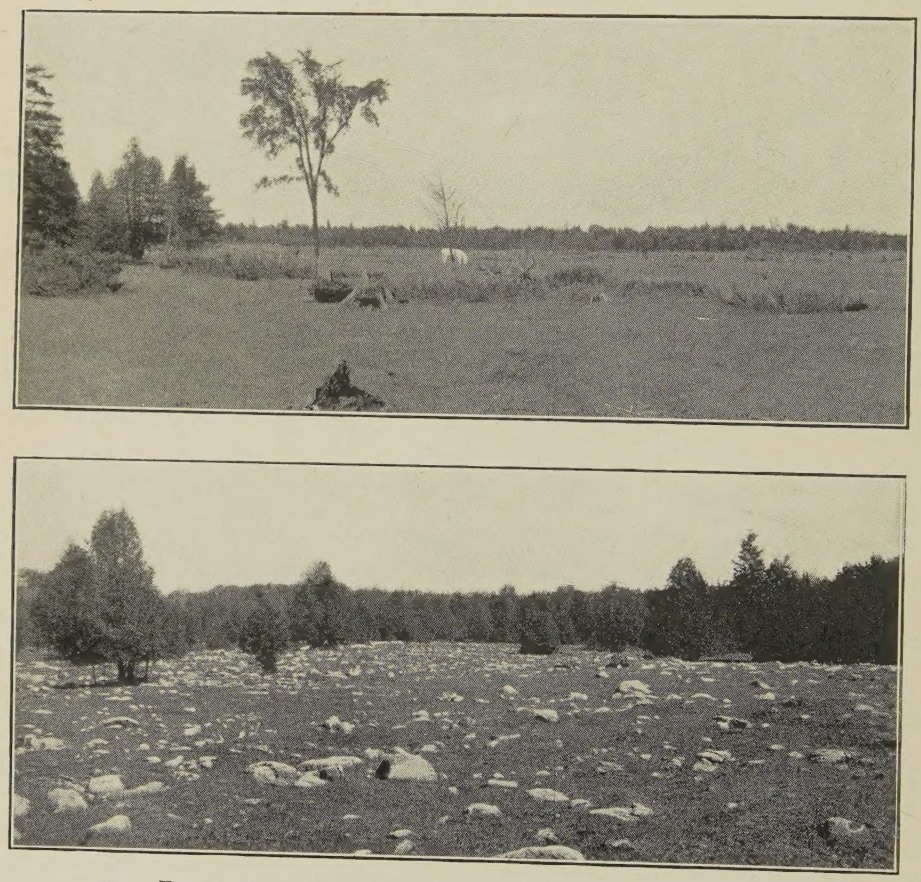

FIGURE 4. Two typical landscapes on the Napanee Plain

shore of Lake Ontario. The rivers flow in a south-west direction, usually following the preglacial channels which are deeply entrenched in the rock, but in many places there are lakes and large swampy areas caused by the blocking of the old channels with glacial drift.

Over most of the area there is a covering of a few inches of soil, but the rock is often exposed. Although deeply covered by the waters of Lake Iroquois, there are no extensive deposits of lacustrine origin. The lower areas near the Bay of Quinté and Lake Ontario were submerged in marine waters, to which Fairchild (*5*) has given the name "Gilbert Gulf," and there are fairly widespread deposits of marine clays. From an agricultural

standpoint, it is to be regretted that the area of marine clay is not larger, for the remainder of the Napanee plain constitutes one of the largest areas of extremely shallow soil to be found in Old Ontario. The clay soils, if carefully cultivated, are excellent for general farm crops but the limestone areas can be utilized only for pasture.

II. The Iroquois Lake Plain

Exclusive of the area just described, the waters of Lake Iroquois covered an area of about 900 square miles, comprising a narrow strip from two to ten miles wide along the shore of Lake Ontario together with a wide island-studded embayment in the Trent valley. Coleman (*3*) has mapped and described the ancient shore features. There are many miles of well-developed beaches as well as deep delta deposits such as those of the Humber, Don, Ganaraska and other rivers, which have served for many years as sources of sand and gravel. Behind the beaches and bars in many places are swampy areas which were lagoons along the edge of the ancient lake just as there are today at Toronto, Frenchman Bay, and Port Darlington on Lake Ontario. One of the largest of these ancient bays is situated at Hampton just north of Bowmanville while another very good example is to be seen near Greenwood on No. 7 Highway.

For much of its length the Iroquois shore line lay against drumlins and ground moraine deposits which were undercut by the waves, producing broad terraces and steep high bluffs. The finer materials were washed away into deep water, leaving the stones to form a "boulder pavement." Good example of rocky areas of this type are to be found both east and west of the Greenwood embayment. Many miles of the old shoreline are marked by such stony land, which, in addition, is often swampy because of seepage from the hills behind. Much of this borderland is still wooded.

Farther off shore there are fairly extensive areas of clay and silt, but even deeply submerged localities sometimes exhibit a till surface. This is especially true of the drumlins north of Cobourg. Near Campbellford and Codrington in the Trent embayment and also on the highway just west of Port Hope, good exposures of "varves" or annual layers are to be seen. These varved clays are usually highly calcareous. In many places the clays are overlain by a shallow loam or fine sand, but there are areas where the soils are developed upon clay.

West of Toronto there is not so much clay although there are some deposits of waterworked red shale near Burlington. Generally the bed-rock is near the surface and the lacustrine sediments consist largely of sands brought down by the Etobicoke, Credit, Oakville and other streams which debouched into the old lake.

The whole area is one of low relief. The topography is flat to gently undulating and there are many swamps and poorly drained areas. Nevertheless, there are also areas in which excellent agricultural soils have been developed and some of the most specialized fruit and truck crop lands are to be found in the Iroquois Lake Plain.

III. The Ontario Till Plain

An area of approximately 800 square miles is covered by the glacial debris or ground moraine of the Ontario lobe of the last ice sheet together with the similar materials deposited in ridges of terminal moraines near its edge at various times. These moraines have been in part studied and described by Taylor (*10*). The area is one of moderate relief; the elevation varies from 400 to 600 feet above sea level at the Iroquois shoreline, to about 1,000 feet on the crests of the moraines. In general the topography may be classed as rolling, but becomes quite hilly in the more elevated districts. The greater part of the region consists of well-drained uplands.

The materials in the glacial debris vary considerably from place to place. Some of the moraines toward the east consist largely of an almost stoneless clay which is highly calcareous. Near Enniskillen and Tyrone it gives a distinct impression of having been a lacustrine deposit which was pushed into its present position by advancing ice. Other ridges, however,

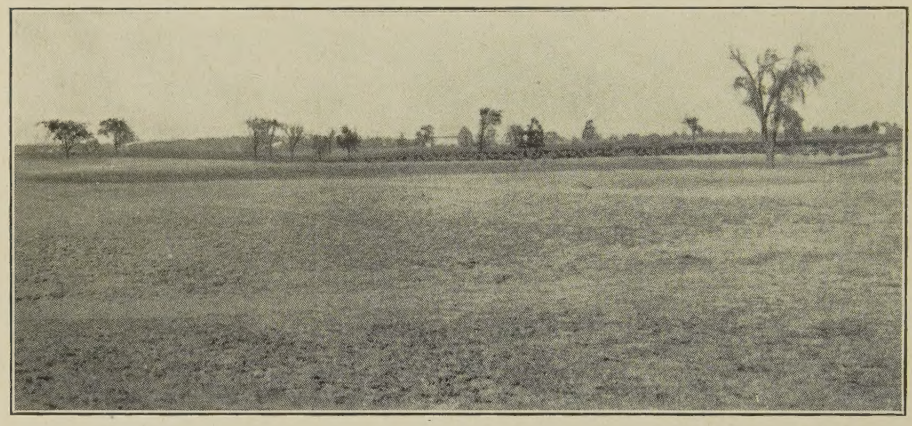

FIGURE 5. Ontario Till Plain topography in Halton County.

are made up of a more sandy material containing many large erratic boulders. North-west of Oshawa and Whitby in Ontario county, and extending into the district about Stouffville in York county, there is an area of limestone till which, on the whole, has undergone very little weathering. As one travels westward, the percentage of limestone in the till decreases and the influence of the underlying shales becomes predominant. West of the Credit River the surface deposits contain large amounts of red shale from the underlying Queenston (Medina) formation; indeed over considerable areas these shales are exposed at the surface without any drift covering whatever. In the northern parts of York and Peel counties there are clay moraines which are apparently also disturbed lacustrine sediments, but they are not so calcareous as those mentioned above.

Good agricultural soils are developed upon all of the different types of till. They are usually loams and clay loams whose characteristics largely reflect the origin of the parent material. Those developed upon a highly calcareous till are alkaline while those developed upon a shaley till are inclined to be acid. The region is one adapted to general farming, while nearness to Toronto and other cities has resulted in the development of the whole milk trade.

IV. The Peel Lake Plain

Taylor (*10*) has described the Scarborough moraine which extends from the edge of the Niagara Escarpment near Nelson, eastward past Toronto and Scarborough and thence somewhat north-east to Claremont. It represents the marginal deposit laid down during a halt in the retreat of the Ontario lobe. North of this position of the ice front, there is in Halton, Peel and York counties an area of over 300 square miles which shows evidence of having been submerged. The shorelines of this lake are vague, but its northern limit almost coincided with the Bolton moraine (*10*). The water level is established by two deltas, one in the Humber at Nashville and the other at Norval in the Credit. It is thought that the waters escaped along the edge of the Niagara Escarpment.

The deposits of this lake consist chiefly in a veneer of clay superimposed upon the surface of the Ontario Till Plain. In many places the clay is shallow and forms the surface layers of the soil only, but elsewhere there are deeper deposits in which varves may be seen distinctly below the weathered soil material. The nature of the clay varies: over most of the area in York and Peel counties the subsoil is calcareous, being derived from ground-up limestone from the east, while west of the Credit the clay is composed of shale debris which contains much less lime.

The topography of the lake plain is in contrast to the rolling till plains which surround it, being gently undulating and in some localities quite flat. Level tracts are to be seen near Milton in Halton county, and near Unionville in York county. The country has been described as "bevelled," since the hills have apparently been planed off by the lake waters, while the hollows have been filled with clay. The plain is crossed by a number of deeply entrenched streams, and as a whole is fairly well-drained although a few swampy areas remain. The agricultural development has been quite similar to that of the till plain.

V. The Interlobate Areas

The detritus which was deposited between the two ice lobes constitutes the most elevated, hilly, and agriculturally worthless land in the region. It, together with certain other areas of much the same characteristics, covers about 600 square miles. Most of it is more than 1,000 feet above sea level.

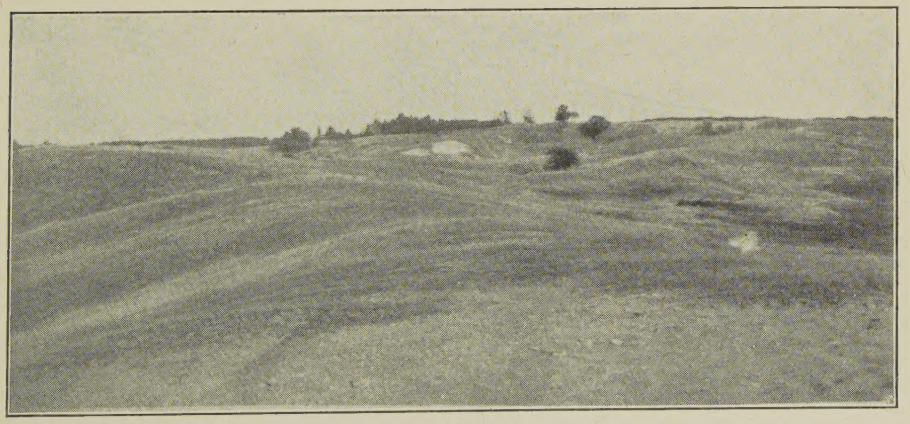

FIGURE 6. View of topography in the Interlobate Area.

An "interlobate area" is to be thought of as a place in which there was great rush of meltwater, and the deposits are for the most part those of rapidly moving streams. Deltas, kames, kame moraines and outwash plains are common. The materials are chiefly deep sands and gravels overlying till moraines, although in places they must have been held up by ice walls alone. There are also some areas of deep water deposits in which varved silts and clays occur.

Historically, these deposits are the earliest in the region for they were uncovered when all the rest of the country, both north and south, was still deeply buried beneath the ice lakes. The drift is very deep, some of it undoubtedly belonging to an earlier ice age. In the area just south of Uxbridge a different type of till is sometimes exposed in the deeper gullies. Most of the deposits are calcareous; the amount of shale in the interlobate drift is not great, but some of the sands have lost most of their lime through leaching. In the tract north of Barrie there is much less lime since a great deal of the material is of Precambrian origin. Since the removal of the forest cover considerable gullying has taken place, while some of the more sandy areas have been badly windblown.

VI. The Schomberg Lake Plains

During the retreat of the northern ice lobe a series of temporary glacial lakes was held up between the ice front and the interlobate moraine. To the chief lake the name Schomberg has been given because the nature of the deposits was first recognized near the village of that name situated on the borders of York and Simcoe counties. In addition to this there were other similar pondings eastward along the north side of the interlobate area, some of which may have been contemporaneous. All of these have been included in the Schomberg Lake Plains and together they constitute an area of about 475 square miles of lacustrine sediments.

FIGURE 7. Deep varved clay bed near Holland Landing.

Varved clays and silts comprise the bulk of the materials, but in some places sandy deltas are found. The depth of the clay deposit is largely unknown, although many exposures of ten feet or more have been observed. Recent road-building operations near Holland Landing have exposed nearly fifty feet of varved clay, but this is probably exceptional. Over much of the area the varves are remarkably thick; those exposed at Holland Landing average about seven inches. The Schomberg clay is to be regarded as limestone rock flour; chemical analyses show it to contain about 50% of calcium carbonate. Mechanical analysis indicates that it is very finely divided, over 50% being clay while an additional 40% can be classed as silt. In other parts of the area there are coarser textured deposits which are less calcareous.

FIGURE 8. Topography of the Schomberg Lake Plains.

Topographically the area is undulating to moderately rolling, with somewhat greater relief than is usually associated with a lake plain. The continuity of the lacustrine sediments is somewhat interrupted by numerous till hillocks and ridges. The stream valleys are quite well developed and the drainage is good except for seepage areas which are found along the bases of the hill ridges. The eastern extension of this region, which occupies a number of narrow valleys, is much more handicapped in this regard than are the broader areas in Simcoe and York counties.

VII. The Limestone Moraines

This area which is some 500 square miles in extent was the last of our region to be freed from the ice, the actual deglaciation taking place after the downdraining of Lake Iroquois. It comprises a rather narrow band of rough country just south of the Shield, and along the edge of the limestone cuesta, from which most of the rock debris was derived.

Most of the surface is below 700 feet in elevation and would have been flooded by Lake Iroquois, had the ice not been present. Although

very rough and rocky there are no great differences in elevation, for it is in reality an extension of the Napanee Plain, upon which has been heaped a large amount of coarse limestone drift. Owing to the clogging of ancient stream channels there are a number of lakes and swamps, but the nature of the morainal material ensures that the hills and ridges have good drainage.

FIGURE 9. A typical landscape in the region of the Limestone Moraines.

Agriculturally this area is not of great importance. Much of it is too rough or too swampy, while those areas which by reason of topography and drainage might be suitable for tillage are often thickly studded with limestone boulders.

VIII. The Drumlin Belt

The Drumlin Belt is the largest, and in many ways the most interesting, subdivision of South-central Ontario. It covers an area of approximately 2,000 square miles and includes some of the best of Ontario's farm lands. The surface of this belt comprises the greater part of the ground moraine of the northern ice lobe which, because of its wide distribution, tends to merge with all of the adjoining deposits. Particularly is this so at the eastern end of the belt which was flooded by the waters of Lake Iroquois, and at the western end which was submerged by the Schomberg ponding and by Lake Algonquin. In spite of the flooding, however, much of the peculiar drumlinoid form has been retained although the depressions have been covered by clay deposits.

Drumlins are among the most interesting structures to be found in connection with glacial deposits. Their forms vary somewhat, but typically they are oval hills about a mile in length and a third of a mile in width with a height of fifty to one hundred feet. The name "drumlin" is Celtic in origin and was first applied to typical hills of this nature occurring in Northern Ireland. Large drumlin fields have been described in Wisconsin, Michigan, New York and New England. Goldthwaite (*8*) reports the

FIGURE 10. *Upper.* Side view of a small drumlin.
Lower. The rolling topography of drumlinized upland.

FIGURE 11. A section of a roadcut through a drumlin showing the stony character of the exposed till.

occurrence of great numbers of drumlins in Nova Scotia; but although mentioned by Taylor (*11*) little has been written on the drumlins of Ontario.

It is estimated that there are at lest 3,000 large, well-formed drumlins in the region, in addition to many "drumlinoid" ridges and "flutings" of the drift. The drumlins vary greatly in size. Some of them are very small, being mere swells in the ground moraine—less than ten feet in height and but a few rods in length. Some of the longest stretch for nearly two miles, while a number of hills are known which, according to the contours on the map, are over 200 feet in height. Very large drumlins may be seen near Dartford and Roseneath, just southeast of Rice Lake. Another very large drumlin is Anthony Hill, a few miles south of Omemee.

The drumlins were formed beneath the ice, probably largely in the nature of pressure ridges due to inequalities in the pressure of the ice upon its drift-laden lower strata. Alden (*1*) thinks this unequal pressure is due to the radial flow of ice in the lobes. A good summary of the facts relating to drumlin formation is given by Fairchild (*6*). The long axes are parallel with the direction of the ice flow in the lobe, which is from northeast to southwest in most of the area, but varies in different localities, as shown in Figure 2. East of Rice Lake it is almost north and south, while in the neighbourhood of Lake Simcoe it is only slightly south of east and west. The smooth surface and moulded form of most of these hills show that they were overridden by the ice, but they are not erosional forms for they have been built up by a "plastering on" process instead of being carved from pre-existing drift. Their formation took place in a zone not far behind the edge of the ice lobe at a time when its lower portions were overladen with debris.

The surface of the Drumlin Belt is not all equally drumlinized. Neither are the materials of the till exactly the same in all parts, but all are derived from Paleozoic limestones together with some Archaean boulders and rock debris. The well-formed drumlins of Peterborough county are composed of limestone boulder clay containing large numbers of small, well-rounded stones of the same material. In some places they are so numerous as to give to exposed banks the appearance of gravel. Some larger limestone boulders up to a foot in diameter also appear in the till. The surfaces of the drumlins are often well studded with boulders, largely of Precambrian origin. Large drumlins are to be found in Huntingdon township, Hastings county, in Northumberland county just southeast of Rice Lake, and in the northern part of Durham county. In these places the drift is quite deep. The greatest concentration of drumlins seems to be in Peterborough county just north of Rice Lake where the drift is of moderate depth. There are about twenty drumlins forming islands in Rice Lake. The city of Peterborough itself is built upon drumlins.

Westward, in Victoria county, the drift is thinner and the drumlins are not so well developed. Numerous low ridges, however, run in the same direction as the drumlins; while in certain localities small groups of typical drumlins occur. The drift in this area is derived from a nodular Trenton limestone and contains a great many angular fragments, while Archaean boulders are not so frequently encountered. In the southern parts of Victoria county there are large tracts covered by clay deposits while in some of the northern districts there are surface deposits of sand.

In Ontario county just northeast of Lake Simcoe there is a small area containing well-formed drumlins where the materials of which the drift is composed are similar to those of Peterborough. This region was entirely submerged by Lake Algonquin and the lowlands are covered by clay deposits. Southward—along the border of the Interlobate, and westward —around the southern end of Lake Simcoe, the character of the till changes somewhat, being more loamy and not so highly calcareous. In some places along the border of the Interlobate, the drumlinoid form is inclined to merge with the till plains which are composed of much the same materials. West of Lake Simcoe not so many typical drumlins are found but there are numerous long, rounded ridges which are oriented in the same direction.

FIGURE 12. A view along the crest of an esker.

The field of the northern ice lobe is remarkable, not only for its drumlins, but also for its numerous eskers. The latter are gravel and sand ridges of various sizes, winding in serpentine fashion across the country, their general direction being parallel to that of the ice movement. It is generally supposed that they represent the deposits of meltwater streams flowing in tunnels beneath the ice. The gravels are stratified and often foreset in the direction of the ice front. Eskers are later formations than drumlins, for the latter were formed beneath the advancing ice while the former were deposited during its final melting and retreat.

Some of the eskers are very large, having a height of seventy-five to one hundred feet above the surrounding country. Some of them are quite short, being less than a mile in length while many have a length of several miles—one of which can be traced more or less continuously for over 50 miles. Good examples of eskers may be seen at Cannington, Cameron Lake, Omemee, Norwood, Stirling, Tweed and Marlbank. The surfaces of the esker ridges, themselves, are not agriculturally important, being much too steep and gravelly. However, in the vicinity there are often extensive sand deposits which do have a considerable influence upon the soils of the region. As sources of sand and gravel, the eskers have been important locally in the program of highway construction.

Both drumlins and eskers are very striking earth forms whose presence in the ground moraine of the northern ice lobe is in great contrast to the

much weaker development of surface features in the Ontario Till Plain, and probably indicates a difference in the manner of ice movement in those parts of the two ice lobes.

IX. The Algonquin Lake Plain

The lowlands bordering on Georgian Bay and Lake Simcoe, which were covered by the waters of Lake Algonquin, have an area of nearly 1,200 square miles. Included in this area are the deposits of the later and lower Nipissing stage of the Great Lakes. The altitude of the Algonquin beach in this region increases northward from 724 feet near Schomberg to about 900 feet above sea level at the edge of the Precambrian Shield. Goldthwaite (*7*) gives an account of these beaches and the amount of their northward deformation, while Johnston (*9*) describes the ancient outlet by way of the Trent Valley.

FIGURE 13. Flat clay plains in the old Algonquin lake bed north of Orillia.

The topography over a large part of the area is quite flat and much of the land is poorly drained. In the basin of Lake Simcoe and in the valley of the Nottawasaga, there are large marshy tracts. The best known of these is the Holland marsh which in recent years has been reclaimed and brought under cultivation for market gardens. The surface deposits in the valley of the Nottawasaga are often sandy although underlain by heavy clay at a depth of several feet. In some places the sands are very light and "blow-sand" areas occur, such as are found in the vicinity of Camp Borden. Along the shore of Georgian Bay there are extensive sand dunes, also wind-blown. Sand plains occur near the margin of the old lake in York county just south of Lake Simcoe, and in the northern parts of Simcoe county. Several areas of heavy clay deposits are known, the most extensive being those north of Beaverton on the east side of Lake Simcoe and in the flat country north of Orillia. Another clay tract is found in the vicinity of Elmvale. Extensive deposits of marl are found near Minesing, where there was for a time a large shallow body of water connected with Lake Nipissing.

Northeast of Lake Simcoe there is the group of drumlins, already referred to, which was submerged in Lake Algonquin; and, adjoining this along the edge of the limestone cuesta, there is a large area of bed-rock covered by a few inches of soil, similar to that of the Napanee Plain.

The beach deposits of Lake Algonquin are well developed, especially in the northern part of Simcoe county. Around each of the ancient islands forming parts of the Simcoe uplands there is a series of beaches at vertical intervals of a few feet. A great many of the slopes have been cleared of trees, and these "stepped hillsides" are striking features of the landscape near Midland and other places. Here also, as was noted along the Iroquois shoreline, wave action against the glacial till of the uplands has produced extensive boulder pavements. Much rocky land of this nature is to be found near Midland and Penetanguishene, while another similar tract is located west of Collingwood. Such land as a rule can be utilized only as pasture; although with a very great expenditure of labour some of it has been cleared and brought under cultivation.

X. The Simcoe Uplands

The Simcoe uplands comprise a number of islands and peninsulas which interrupt the Algonquin Plain. It is, therefore, not a continuous area, as are some of the others which have been discussed. It is also the smallest, having an area of approximately 300 square miles.

FIGURE 14. Typical "boulder pavement" of the old Algonquin shore line in the northern part of Simcoe county.

The boundary between this division and the Drumlin Belt is not very definite and is mainly determined by the nature of the till. The characteristics of the scattered northern units of this region are fairly uniform. The top of each is an undulating plain having an elevation of about 1,000 feet above sea level. The chief exception to this is found a few miles north of Barrie where there are extensive deposits of sand and gravel of an interlobate character, the ridges of which reach an elevation of over 1,200 feet.

FIGURE 15. Coldwater Valley, an arm of ancient Lake Algonquin lying between two sections of the Simcoe uplands.

The materials comprising the till in this region differ from those in other places because, although the underlying rock is limestone, the drift has been very largely derived from the adjoining Precambrian formations. Hardly any limestone fragments are present and no free carbonates are found in the till. Texturally, the material contains very little clay in comparison with the limestone and shale tills, and the soils tend to be sandy loams. Great numbers of archaean boulders are to be found, particularly in the more northerly locations where they are especially emphasized in the "boulder pavements" of Lake Algonquin. It is a fair general farming region in which the rocky land is devoted to pasturage.

SUMMARY

A knowledge of the physical geography of any region is prerequisite to an understanding of its cultural development, and nowhere is it more necessary than in a study of its agricultural capabilities. The characteristics of the soil are of primary importance and it is easily understood that the nature of the parent materials, in a very large measure, controls the development of the soil. Geology and physiography are important considerations in connection with a soil survey or a review of agricultural resources.

The important geological features are those on the surface and hence, very largely, of glacial origin. The triangular region of South-central Ontario, underlain by the comparatively soft Ordovician rocks, in itself constitutes a good physiographic unit; but there are differences in elevation and topography, as well as in the nature and origin of the surface deposits, which render it necessary to make subdivisions. Since, from an agricultural standpoint, the chief importance is attached to the formation upon which the soil is developed, the physiographic subdivisions have been based primarily upon the major differences in the surface deposits. The chief characteristics of the ten regions which have been discussed are summarized in Table 1.

TABLE 1.—SUMMARY OF THE PHYSIOGRAPHIC REGIONS OF SOUTH-CENTRAL ONTARIO

Region	Area in sq. mi.	Elevation in ft. above sea level	Topography	Character of surface deposits	Agriculture
Napanee Plain	1200	245–600	Gently sloping plain.	A few inches of soil over rock.	Pasture.
Iroquois Lake Plain	900	245–600	Undulating plains.	Chiefly stratified clay, silt and sand.	Somewhat specialized toward fruit growing.
Ontario Till Plain	800	400–1000	Rolling plains.	Limestone or shale boulder clay.	General farming and dairying.
Peel Lake Plain	300	600–800	Undulating plain.	A veneer of clay over till.	General farming and dairying.
Interlobate Areas	600	1000–1200	Hilly.	Sand and gravel.	Forestry.
Schomberg Lake Plains	475	750–900	Gently rolling.	Stratified clay and silt.	General good farming region.
Limestone Moraines	500	500–700	Hilly.	Coarse limestone debris.	Poor farming land but of some use for pasture.
Drumlin Belt	2000	500–1200	Rolling to hilly.	Stony, calcareous till.	Good general farming region.
Algonquin Lake Plain	1200	600–850	Level to undulating.	Stratified clay sand and silt.	Moderately well adapted to general farming.
Simcoe Uplands	300	Average—1000	Rolling.	Non-calcareous stony till.	General farming.

With respect to the age of the deposits little need be said. Various estimates of post-glacial time have been given by Spencer (*12*), Coleman (*4*), Antevs (*2*) and others. The Interlobate areas were the first to be uncovered and their deposits are plainly the work of meltwater escaping along the ice face. The till plains and drumlin areas are next in order and are in part older, and in part more recent, than the high level lake plains which occupy portions of their surface. Among the more recent deposits are those found in the Algonquin and Iroquois Lake Plains, including the Napanee Plain with its deposits of marine clay. The limestone moraines are also fairly recent since they were not uncovered by the ice until after the down-draining of Lake Iroquois.

From a strictly physiographic viewpoint there may be too many subdivisions, but on the other hand, each of these units could be subdivided into several lands types. To have omitted any of the ten, however, would have been to obscure many well-defined differences. The boundaries of the different subdivisions are in places necessarily approximate since they are based upon the predominant surface materials. A case in point is to be found in the Trent embayment of Lake Iroquois where a large part of the surface is made up of islands of till protruding through the lacustrine sediments.

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Although we have stressed the importance of the nature and attitude of the unconsolidated surface materials in relation to soil development, there are other points to be considered as well. Land form has an effect upon agriculture through its influence upon size of fields, use of machinery, control of soil erosion, and other problems of farm management. It is to be remembered also, that topography and elevation have a climatological bearing upon the agriculture of a region. Any marked difference in elevation or direction of slope may make a difference of several days in the length of the growing season. Indeed, there are many ways in which the geographer can make use of physiographic data, but apart altogether from practical considerations it is of scientific interest in itself to collate and examine the facts relating to the surface of the country.

ACKNOWLEDGMENT

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Résumé

La physiographie de la région centrale de l'Ontario-Sud. D. F. Putnam et L. J. Chapman, Institut de recherches de l'Ontario, Toronto, Ont.

Les traits géographiques importants de ce district sont ceux de la surface; ils sont donc en grande partie d'origine glaciaire. La région triangulaire du centre de l'Ontario-Sud, qui repose sur des roches ordoviciennes relativement tendres, constitue

en elle-même une bonne unité physiographique; mais il y a des différences d'altitude et de topographie ainsi que de nature et d'origine dans les dépôts de surface, qui obligent à faire des subdivisions. Au point de vue agricole, c'est la formation sur laquelle le sol s'est développé qui présente le plus d'importance, et c'est pourquoi les subdivisions physiographiques ont été basées principalement sur les principales différences que présentent les dépôts de surface. Les caractères principaux des dix régions à l'étude sont résumés dans le tableau 1.

En ce qui concerne l'âge des dépôts, il est inutile d'en dire bien long. Les premières étendues mises à découvert sont les régions entre lobes et leurs dépôts sont évidemment l'œuvre de l'eau des glaces fondantes. Viennent ensuite les moraines médianes et latérales dont une partie est plus ancienne, et une partie plus récente que les plaines des lacs de haut niveau occupent une partie de leur surface. Il y a parmi les dépôts les plus récents ceux que l'on trouve dans les plaines des lacs Algonquin et Iroquois, et qui comprennent la plaine de Napanee avec ses dépôts d'argile marine. Les moraines de pierre à chaux sont aussi assez récentes, car la glace dont elles étaient recouvertes ne les a quittées qu'après l'égouttement du lac des Iroquois.

Au point de vue strictement physiographique, il peut y avoir trop de subdivisions; par contre, chacune de ces unités pourrait être subdivisée en plusieurs types de sols. Cependant, l'omission de l'une quelconque des dix régions aurait caché un grand nombre de différences bien définies. Dans quelques subdivisions les limites sont parfois nécessairement approximatives, car elles sont basées sur les matériaux principaux de la surface. Un exemple est celui de la baie de Trent, du lac des Iroquois, où une grande partie de la surface se compose d'îles faisant saillie à travers les dépôts lacustrés.

THE RECENT DROUGHT SITUATION IN SOUTHWESTERN MANITOBA[1]

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The Southwestern portion of Manitoba, in common with Western Canada and the United States, has been severely affected by the general drought which occurred during the years 1929 to 1934 inclusive.

Drought is a relative term, but in local usage commonly indicates a climatic condition under which the regional vegetation and the crops are not able to obtain sufficient water for normal growth in that region.

Drought, however, is not a simple phenomenon. The inability of plants to obtain the required amounts of water may be due either to "atmospheric drought," which is general; to "soil drought," which may be either general or local; or to "physiological drought," which is extremely local. "Atmospheric drought" is a climatic condition. It may be of short duration and may produce temporary wilting, or it may be long continued and of serious consequences to vegetation. "Soil drought" is a condition under which the soil is unable to supply the plants with the water required. It may result from continued "atmospheric drought" and low precipitation, so that all the well-drained soils under vegetation become dry, or, it may be very local because of the excessive reduction of soil water by specific plants or crops, so that the soil is much drier than that of adjacent soil under other crops. For example: the soil under an old alfalfa stand will be much drier than that under well tilled corn. Local "soil drought" may result also from shallowness of soil and restricted root room, from the occurrence of coarse textured soil materials (with low water retention capacity), or from the locally-arid soil conditions which occur on knolls, slopes, etc., due to water "run-off" or to other factors. "Physiological drought" may result from such causes as salinization or excessive concentration of electrolytes in the soil solution.

DROUGHT PERIODICITY

The drought of recent years in Western Canada was one of the widespread periodic occurrences of lower than normal seasonal precipitation not uncommon in continental steppe regions. Strange (*3*) cites the writings of Thompson 1784–1807, Hind 1857–1858, Palliser 1857–1860, and Macoun 1872–1879, giving evidence of the occurrence of drought conditions in Western Canada prior to settlement; and subsequently, the experience of the settlers and the meteorological records show that drought conditions have occurred at irregular periods since settlement in Southwestern Manitoba. In this connection it is of interest to review the periodicity of drought occurrence as far as meteorological data are available.

[1] This work was carried on in collaboration with the Dominion Experimental Farms in the laboratories of the Soils Division, University of Manitoba. Paper presented at the Soils Group Session, C.S.T.A. Convention, University of Alberta, Edmonton, June 25, 1935.

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The meteorological data available for the stations in Southwestern Manitoba cover a period of only 49 to 50 years. In this area there are five meteorological stations with usable records. From the data available (*2*) a comparison was made of the precipitation and the yields of the principal crop grown (*i.e.*, wheat). In this study the monthly precipitation of all stations was averaged, and the yearly and seasonal means for precipitation throughout the area, from 1884 to 1933, were obtained for comparison with the district yields of wheat (*1*). As the wheat crop in this area has generally completed its growth by the beginning of August, the precipitation values were grouped by months as follows: *(a)* "Previous fall"—August to October; *(b)* "Winter precipitation" (snowfall expressed as inches of water), November to March; and *(c)* "Growing season"—April to July. From the values obtained, wheat yield × precipitation, correlations were calculated with the results shown in Table 1.

TABLE 1

Years			R	t	Probability	
1885 to 1933	Yield × Precipitation	"Previous Fall" Aug. to Oct. and "Growing Season" April to July	.5733	4.7588	Greater than 0.01	All correlations highly significant
	Yield × Precipitation	"Growing Season" April to July only	0.5056	3.9741	Greater than 0.01	
	Yield × Precipitation	"Annual" Aug. to July	0.3384	2.4123	Approximately 0.02	

N = 48 years. The crop report of 1888 omitted the yields of wheat because of the frozen crop of that season.

These figures indicate that the wheat yields show a better correlation with the rainfall of the previous fall months, August to October, plus that of the wheat growing season, April to July, than with that of the current growing season. Also, when the snowfall values are included, the correlation value falls. Hence as a measure of precipitation for this area, the rainfall which falls during the "Previous fall," (August to October) plus that of the wheat "Growing season" (April to July), may be taken as the criterion of a given season being relatively moist or dry. The average precipitation values thus obtained for the years 1855 to 1933 are submitted in Table 2. The district average wheat yields and precipitation are presented graphically for comparison in Figure 1.

From the standpoint of relatively low precipitation (or drought) years, it is interesting to note that from 1885 to 1916, the rainfall values fluctuated above and below the 49-year average in short periods only, so that after one or two dry seasons, years with higher precipitation occurred. From 1917 to 1933, however, there occurred two long periods of relatively dry years (or drought), and one long period of relatively moist years. As 1934 was also very dry, the period of 1917 to 1934 had two periods of drought of six years' duration to one period of six non-drought years. A fifty year period is too short to show whether or not excessively severe droughts occur over long cycles as is sometimes suggested, nevertheless the past

TABLE 2.—"PREVIOUS FALL" AND "GROWING SEASON" PRECIPITATION VALUES IN SOUTH-WESTERN MANITOBA. (1885 TO 1933)

Mean of all Stations reporting, including Waskada, Deloraine, Pipestone, Pierson and Hartney

Year	Precipitation Previous Fall: August to October, and April to July, inclusive	Deviation from the mean		Duration of years with above and below mean moisture values	
				(+)	(−)
1885	16.84 inches	3.37		1	
1886	11.68 inches		1.79		1
1887	16.10 inches	2.63		2	
1888	14.14 inches	0.67			
1889	6.80 inches		6.67		1
1890	17.12 inches	3.65		2	
1891	26.36 inches	12.89			
1892	10.41 inches		3.06		
1893	11.92 inches		1.55		3
1894	12.84 inches		0.63		
1895	20.64 inches	7.17		2	
1896	16.35 inches	2.88			
1897	9.94 inches		3.53		2
1898	13.34 inches		0.13		
1899	18.45 inches	4.98		1	
1900	9.00 inches		4.47		1
1901	19.39 inches	5.92		1	
1902	11.55 inches		1.92		2
1903	8.02 inches		5.45		
1904	15.03 inches	1.56		1	
1905	10.26 inches		3.21		1
1906	17.38 inches	3.91		1	
1907	8.50 inches		4.97		1
1908	16.64 inches	3.71		1	
1909	13.21 inches		0.26		
1910	5.12 inches		8.35		3
1911	10.71 inches		2.76		
1912	18.35 inches	4.88		1	
1913	13.11 inches		0.36		1
1914	19.63 inches	6.16		1	
1915	10.44 inches		3.03		1
1916	15.22 inches	1.75		1	
1917	10.77 inches		2.70		
1918	7.47 inches		6.00		
1919	12.84 inches		0.63		6
1920	13.05 inches		0.42		
1921	8.99 inches		4.48		
1922	13.25 inches		0.22		
1923	14.96 inches	1.49			
1924	15.83 inches	2.36			
1925	13.59 inches	0.12		6	
1926	15.04 inches	1.57			
1927	22.37 inches	8.90			
1928	18.37 inches	5.29			
1929	9.51 inches		3.96		
1930	8.39 inches		5.08		
1931	6.46 inches		7.01		5
1932	12.95 inches		0.52		
1933	11.25 inches		2.23		
	Mean 13.47		Mean	21	28

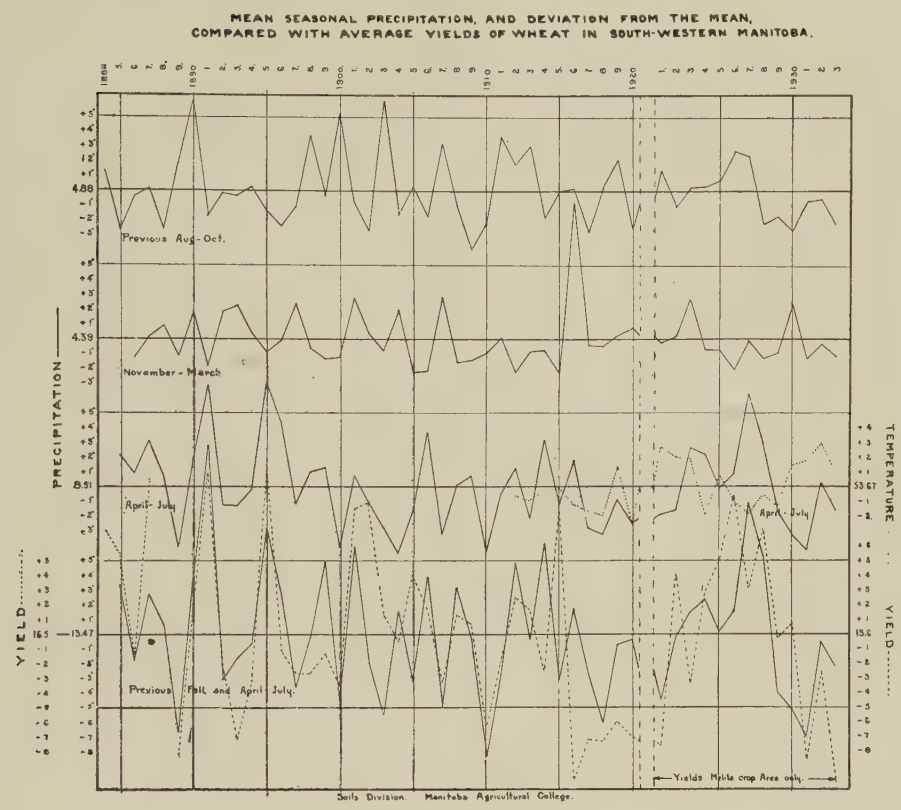

FIGURE 1

history of the area definitely shows that recurring periods of moist years, irregularly alternating with dry or drought years, can be expected. Whether the drought years (which are sure to come) will be of short or of long duration we do not attempt to predict. However, if the dry season of 1934 is added to those in Table 1 it is significant to note that during the past fifty years *only twenty-one years show rainfall values above the average for the area*, whereas *years drier than the average occurred twenty-nine times*. Hence the combating of drought must always be of vital importance in this area.

SOIL MOISTURE STUDIES

In connection with the recent drought situation, studies were undertaken during the fall of 1933 and again in the fall of 1934, to ascertain the soil moisture of fields in Southwestern Manitoba. The object of this work was to obtain data on which to base recommendations in respect to cropping and soil management within the area. In 1933 the extreme drought area was confined, in the main, to the municipalities of Edward, Arthur, Brenda, Albert and Cameron. This area divides naturally into three districts:

(1) The "Southeastern" or "Medora-Waskada-Goodlands district," which comprises an area of black and dark brown steppe soils on gently rolling boulder till;

(2) The "Central" or "Cameron-Melita-Bernice district," which forms the prairie plain developed on the sandy to sandy loam deposits in the bed of glacial Lake Souris; and

(3) The "Western" or "Tilston-Pierson district," characterized by aspen-grove-fringed depressions in the more or less sharply undulating prairie on boulder till, which give this district a park-like aspect.

In October, 1933, soil samples were obtained from representative fields throughout this area, and moisture determinations of these soils were made. The soil samples were composites obtained by boring where possible, or, where necessary, from pits dug to the required depths. The soils from each field were divided into five depth samples: (1) 0 to 6 inches; (2) 7 to 12 inches; (3) 13 to 24 inches; (4) 25 to 36 inches; and (5) 36 to 48 inches. Thus 220 soil samples in all were obtained and the moisture present in each at the time of sampling was ascertained, by weighing in the field as sampled, and by oven drying later in the laboratory. Moisture equivalent determinations were made also of each soil sample so that the relative moisture condition of the soils could be ascertained.

In general, the fields sampled were either fallow or stubble fields, but corn, sweet clover, and native sod fields were sampled whenever they could be obtained. The data obtained from these moisture studies are summarized in Table 3. This table shows the inches of available water present in each 4-foot column; the inches of water required to bring the soil moisture up to the moisture equivalent; the moisture retention capacity of each soil column as calculated from the respective moisture equivalents; the field notations of the moisture condition at the time of sampling; and the ratio of the moisture present to the moisture equivalent or normal field capacity. In this table the fields are listed in the order of fallow, stubble, corn, sweet clover and native sod.

The data in Table 3 show that two different moisture conditions existed in the soils of the area studied at this time (October, 1933), namely: (1) the sub-soils of some fields were dry and increasingly dry with increasing depths, and (2) the sub-soils of other fields were moist (or intermediate to moist) and increasingly moist with increasing depth. These facts are shown graphically in summary form in Figure 2.

The fields with dry sub-soils were found to occur on the clay loam soils on the boulder till in the southeastern and western districts. The fields with moist sub-soils occurred only on the sandy or sandy loam textured soils of the lacustrine sediments in the Lake Souris basin. The difference in the moisture relationships of these two groups of soils are striking and show fundamental differences. The average field moisture retention capacity of the fallowed fields on the boulder till, to a depth of four feet, was 8.76 inches of water, and that of the corresponding stubble fields was 8.16 inches. These average figures of slightly more than two inches of water retention capacity per foot, indicate medium to medium heavy textured soils, which can be made to store sufficient water in the upper four feet to produce a crop, if properly summer-fallowed; provided, of course, that sufficient rain falls during the fallow year. The so-called fallow fields of this area in 1933 were covered with extensive growths of Russian thistle and other weeds so that the objective of storing water by fallow was not achieved. The average field moisture retention capacity

TABLE 3.—SUMMARY OF FIELD MOISTURE CONDITIONS IN SOUTHWESTERN MANITOBA, OCTOBER, 1933

M—Moist. I—Intermediate. D—Dry. P—Powder dry. W—Wet.

Treatment	Sample No.	Inches water present to 4 ft. depth	Inches water required to bring 4 feet of soil to maximum moisture capacity	Field moisture capacity to a depth of four feet (Inches water)	Field notation of moisture by inches					Ratio of moisture present to the moisture equivalent				
					0″ to 6″	6″ to 12″	12″ to 24″	24″ to 36″	36″ to 48″	0″ to 6″	6″ to 12″	12″ to 24″	24″ to 36″	36″ to 48″
Fallow (with dry subsoil)	9	6.24	5.43	11.67	D	I	I	D	I	0.646	0.761	0.712	0.693	0.718
	15	5.24	3.86	9.10	I	D	I	I	I	0.743	0.589	0.711	0.798	0.746
	13	3.58	5.47	9.05	I	D	D	D	D	0.719	0.619	0.649	0.611	0.549
	7	2.92	5.92	8.84	I	D	D	D	D	0.772	0.632	0.569	0.543	0.488
	2	5.56	3.26	8.82	M	I	I	D	D	1.020	0.892	0.766	0.668	0.596
	6	5.12	3.64	8.76	I	I	I	I	D	0.822	0.845	0.757	0.725	0.630
	34	4.66	3.98	8.64	I	I	I	D	D	0.894	0.883	0.616	0.668	0.646
	30	4.78	3.66	8.44	I	M	I	D	D	0.841	0.903	0.766	0.661	0.618
	39	2.94	5.21	8.15	I	I	D	D	P	0.881	0.771	0.530	0.506	0.473
	37	2.28	3.83	6.11	I	I	P	D	D	0.751	0.770	0.461	0.555	0.532
		4.33	4.43	8.76						0.809	0.766	0.654	0.643	0.600
				(In excess)										
Fallow (with moist subsoil)	20	5.29	0.46+	4.83	M	W	W	M	M	1.036	1.174	1.143	1.023	0.995
	44	6.08	1.69+	4.39	W	W	W	W	W	1.314	1.382	1.332	1.184	1.204
	3	5.98	2.01+	3.97	W	W	W	W	W	1.579	1.730	1.638	1.144	1.105
	33	2.27	0.01+	2.26	I	I	M	W	W	0.895	0.849	1.000	1.333	1.556
	23	3.03	1.32+	1.71	M	W	W	W	W	1.057	1.466	1.603	1.710	1.457
		4.53	1.10+	3.43						1.176	1.320	1.343	1.279	1.263
Fallow (in sandy area without apparent sub-irrigation	25	7.12	1.52	8.64	M	M	I	I	I	0.912	0.961	0.915	0.848	0.865
	18	3.51	0.97	4.48	I	I	M	M	D	0.850	0.865	0.965	1.094	0.660
	27	2.14	0.22	2.36	W	W	I	D	I	1.135	1.235	0.817	0.639	0.761
		4.26	0.90	5.10						0.966	1.020	0.899	0.860	0.762

TABLE 3.—SUMMARY OF FIELD MOISTURE CONDITIONS IN SOUTHWESTERN MANITOBA, OCTOBER, 1933—*Continued*

M—Moist. I—Intermediate. D—Dry. P—Powder dry. W—Wet.

Treatment	Sample No.	Inches water present to 4 ft. depth	Inches water required to bring 4 feet of soil to maximum moisture capacity	Field moisture capacity to a depth of four feet (Inches water)	Field notation of moisture by inches					Ratio of moisture present to the moisture equivalent				
					0″ to 6″	6″ to 12″	12″ to 24″	24″ to 36″	36″ to 48″	0″ to 6″	6″ to 12″	12″ to 24″	24″ to 36″	36″ to 48″
Wheat and oat stubble (with dry subsoil)	16	2.51	6.92	9.43	D	P	P	D	D	0.697	0.466	0.408	0.554	0.599
	31	0.51	8.63	9.14	D	P	P	P	P	0.556	0.400	0.343	0.369	0.435
	10	1.18	7.90	9.08	D	P	P	P	D	0.511	0.422	0.382	0.414	0.528
	8	1.17	7.40	8.57	D	P	P	P	P	0.654	0.401	0.355	0.429	0.497
	1	3.47	4.93	8.40	I	D	P	D	I	0.832	0.507	0.467	0.641	0.719
	38	2.67	5.67	8.34	I	P	P	D	D	0.804	0.477	0.405	0.568	0.636
	41	2.73	5.39	8.12	D	D	P	D	D	0.645	0.502	0.489	0.589	0.681
	21	3.10	1.09	4.19	M	W	M	D	D–I	1.014	1.276	0.905	0.631	0.700
		2.17	5.99	8.16						0.714	0.556	0.467	0.524	0.599
Wheat and oat stubble (with moist subsoil)	26	3.53	3.89	7.42	I	M	D	D	I	0.848	0.905	0.575	0.516	0.726
	43	2.82	4.48	7.30	I	D	P	D	I	0.815	0.631	0.474	0.547	0.773
	5	4.02	2.80	6.82	I	D	D	I	I	0.793	0.517	0.677	0.738	0.822
	17	2.88	1.34	4.22	I	I	I	M	I	0.774	0.775	0.789	0.905	0.789
	32	1.64	1.22	2.86	I	D	P	I	W	0.778	0.650	0.439	0.733	1.105
		2.98	2.74	5.72						0.801	0.696	0.591	0.688	0.843
Corn (dry subsoil)	12	3.52	5.56	9.08	D	D	D	D	D	0.679	0.584	0.681	0.601	0.545
Corn (moist subsoil)	4	5.11	2.22	7.33	I	D	I	I	I	0.868	0.561	0.734	0.893	0.829
	42	3.80	3.02	6.82	I	I–D	D	I	I	0.776	0.701	0.626	0.711	0.842
		4.45	2.62	7.07						0.822	0.631	0.680	0.802	0.835
Sweet clover (dry subsoil)	11	1.65	7.84	9.49	D	P	P	P	D	0.539	0.420	0.423	0.488	0.517
	19	2.06	2.44	4.50	P	M	I	D	D	0.481	0.976	0.851	0.514	0.510
		1.85	5.14	7.00						0.510	0.698	0.637	0.501	0.513

TABLE 3.—SUMMARY OF FIELD MOISTURE CONDITIONS IN SOUTHWESTERN MANITOBA, OCTOBER, 1933—*Concluded*

M—Moist. I Intermediate. D—Dry. P—Powder dry. W—Wet.

Treatment	Sample No.	Inches water present to 4 ft. depth	Inches water required to bring 4 feet of soil to maximum moisture capacity	Field moisture capacity to a depth of four feet (Inches water)	Field notation of moisture by inches					Ratio of moisture present to the moisture equivalent				
					0″ to 6″	6″ to 12″	12″ to 24″	24″ to 36″	36″ to 48″	0″ to 6″	6″ to 12″	12″ to 24″	24″ to 36″	36″ to 48″
Sweet clover (moist subsoil)	36	4.73	2.86	7.59	D	D	D	I	M	0.584	0.604	0.526	0.801	1.094
	40	5.90	0.72	6.62	I	I	I	M	W	0.722	0.819	0.859	0.907	1.173
		5.31	1.79	7.10						0.653	0.711	0.692	0.854	1.133
Native sod (with dry subsoil)	14	2.43	6.74	9.17	D	P	P	D	D	0.547	0.440	0.487	0.567	0.598
	35	4.04	4.48	8.52	D	P	D	I	I	0.669	0.450	0.642	0.743	0.745
	22	1.30	5.44	6.74	I	D	P	P	P	0.723	0.608	0.355	0.409	0.454
		2.59	5.55	8.14						0.646	0.499	0.495	0.573	0.599
Native sod (with moist subsoil)	28	3.14	3.78	6.92	I	I	D	D	I	0.838	0.827	0.510	0.540	0.858
	24	3.05	1.38	1.67	W	W	W	W	W	1.181	1.546	1.594	1.912	1.299
	29	1.57	0.22	1.35	M	W	W	M	W	0.973	1.131	1.214	0.973	1.187
		2.59	0.72	3.31						0.997	1.168	1.106	1.142	1.115

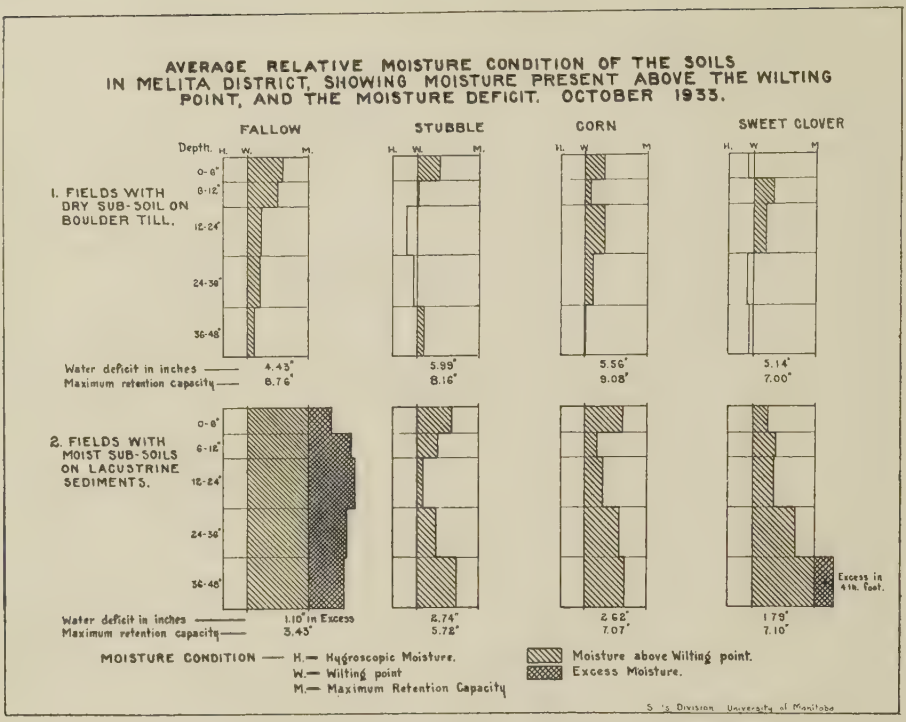

FIGURE 2

of the fallowed fields on the sandy lacustrine deposits, to a depth of four feet, was only 3.43 inches, but the water content at the time of sampling was equivalent to 4.53 inches. In the corresponding stubble, corn, and sweet clover fields the moisture increased with increasing depth although the upper portion of the soil profiles were "intermediate to dry." It is evident therefore that although these soils have a much lower retention capacity than the first group, yet they are moistened by sub-irrigation from below. Soil drifting and surface drought rather than lack of subsoil moisture are the problems on the sandy textured soils of the Souris basin.

During the season of 1934 the area affected by drought in Manitoba extended over a much larger area than in 1933. The area affected in 1934 may be roughly defined as stretching from the western edge of the Red River Valley to the Saskatchewan border, and from the International Boundary northward to the Brandon Hills. A traverse was made through this area in October, 1934, and the soils were examined for moisture content both by digging and boring. With the exceptions of the light textured soils in the Lake Souris basin, the soils of this region occur almost entirely on glacial till and modified drift, and are medium to medium heavy textured. These latter soils all showed *dry to powder dry sub-soils*, and in no case was moist soil found below a depth of eight inches. On the other hand the light textured soils of the Lake Souris basin showed the same *moist sub-soil condition* as were noted in the fall of 1933.

The above observation shows that as far as soil moisture relationships are concerned, the soils in Southwestern Manitoba may be divided into two groups which require different treatment in combating drought.

First Group.—There are the medium to heavy textured soils, chiefly on glacial drift that develop a condition of "soil drought" when subject to continued "atmospheric drought." These soils have good water retention capacity but the moisture required by crops can enter only from above when precipitation occurs.

In the combating of drought in these soils the objects which must be kept in mind are threefold: the first object is to get the moisture into the soil from above; the second object is to hold as much water in the soil as possible until required by the crops; and the third is to plan the fallow-frequency so that crops are not sown on the land unless there is a sufficient reserve of subsoil moisture.

The first of these objects may be secured during the fallow year by keeping the soil open and porous at the surface throughout the preparatory year. This involves the practice of suitable fall and subsequent summer cultivation, so that the rains may penetrate, and the run-off may be reduced to a minimum.[1] Cultivation on the land to be fallowed should commence from the time the last crop is harvested. The land should not be abandoned till midsummer of the fallow year as is generally the practice.

The second object can be secured by preventing all weed growth from the time one crop is harvested until the next crop is sown. This will ensure that the water, which penetrates into the soil, is not used by the growth of undesirable plants.

The third object can be achieved if a field examination of the subsoil of all fields is made in the spring by each farm operator. The subsoil moisture can be estimated by digging into the soil with a spade or post hole digger to a depth of at least four feet. The condition of the subsoil, whether moist, intermediate, dry or powder dry can be ascertained. The fields should then be cropped or fallowed according to the moisture conditions revealed by each examination.

Second Group.—There are the sandy textured soils in the Lake Souris basin which have relatively moist subsoils even after several years of "drought." The water retention capacity of these soils is low, and, as they are very porous, any appreciable amount of water (either as precipitation or as run-off water from adjacent areas) penetrates rapidly through the soil and accumulates at lower levels. The major problem in the management of these soils is the control of soil drifting, and the utilization of the ground water by deep rooted crops. Three lines of endeavor are suggested:

1. Provision must be made to give some form of wind protection by:
   (a) Keeping some cover on the surface such as by:
      (1) the sowing of cover crops,
      (2) the growing of fall rye,
      (3) the use of corn and other intertilled crops as fallow substitutes,
      (4) the spreading of straw or manure on the surface as an emergency measure,

[1] It should be noted that soil drifting is not an acute problem on the soils which have been developed on glacial drift in Southern Manitoba. Drifting may occur during long periods of dessication or if tillage practices are used which pulverize the surface. On these soils drifting can be controlled by suitable tillage practices if the soil is moist.

(5) cultivation practices which will keep the stubble or crop residues at the surface—*viz.*,

I. Plowing with moldboards removed from the plow and the plow share only attached, or,

II. Cultivating instead of plowing, etc.

(b) The reduction of the size of fields by some form of strip farming.

(c) The extensive use of field windbreaks.

2. Provision should be made to increase the organic matter and the water retention of the surface of these soils by:

(a) periodically seeding down to grass and sweet clover, and

(b) the frequent and judicious use of barnyard manure.

3. Advantage should be taken of the subsoil water and high water table, by the growing of such deep-rooted crops as alfalfa, which should be seeded down in moist seasons when conditions are more favorable. The subsoil water should be utilized also to grow field windbreaks of trees and shrubs and thus to obtain surface protection on the cropped land.

In conclusion it may be stated that the drought in Southwestern Manitoba appears to be over for the present. The records of precipitation during the past fifty years, show quite forcibly that drought periods are sure to occur again at irregular intervals. If these drought periods are of short duration, the practices outlined above will enable the farm operator to combat the short drought periods; but, as the drought periods may be of long duration, it is also of first importance that reserves of feed, seed, and money should be carried over from the good years, as an insurance against being compelled to resort to public relief. Finally, the land values should be adjusted and farming operations financed, not on the expectancy of the exceptional good years (that will occur again as in the past), but on the expectancy of the 50-year average which in Southwestern Manitoba is approximately 15.7 bushels of wheat per acre.

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Résumé

La situation de la séchresse dans le sud-ouest du Manitoba. J. H. Ellis, W. H. Shafer, et O. G. Caldwell, Université du Manitoba, Winnipeg, Manitoba.

La sécheresse qui sévissait dans le sud-ouest du Manitoba paraît être terminée pour le moment, mais les relevés de la condensation atmosphérique depuis cinquante ans indiquent de façon très éloquente que les périodes de sécheresse reviendront inévitablement à intervalles irréguliers. Si ces périodes sont de courte durée, les pratiques indiquées permettront aux cultivateurs de les combattre, mais comme elles peuvent être longues, on agira sagement en créant, dans les bonnes années, une réserve de fourrages, de semences et d'argent, pour ne pas avoir à s'adresser à l'assistance publique. Enfin, les valeurs des terres devraient être basées de même que les opérations de culture, non pas sur l'attente d'années exceptionnellement bonnes (qui se reproduiront encore comme dans le passé), mais sur l'attente d'une moyenne de 50 années qui, dans le sud-ouest du Manitoba, est d'environ 15.7 boisseaux de blé à l'acre.

RICE MEAL AS A PARTIAL SUBSTITUTE FOR FARM GRAINS IN THE HOG RATION

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The farmer of Eastern Canada is often handicapped for a suitable and economical basic feed to supplement a shortage of farm-grown grain. Western grains, because of the long freight haul, are usually so expensive in comparison with the returns for animal products that their use is not attractive.

Rice feed is a mill-run by-product of the manufacture of rice products for human consumption: it closely resembles corn in general character, is produced in Montreal, and by previous test has been shown to be of high feeding value. Critical comparisons, however, between this feeding stuff and farm grains (barley and oats) have not been made, and hence its substitution values in the farm ration have not been established.

Chemical analysis reveals the following information concerning the nature of this feed:

Moisture	9.5%	Starch	49.5%
Crude protein	12.6	Fibre	5.6
Fat	13.7	Ash	9.1

In general it is a mixture of about three-quarters rice bran and one-quarter rice polishings and germ.

From consideration of its chemical analyses, one would expect that the greatest value would be obtained from this feed as an ingredient in rations where low fibre and high energy value are of especial importance, and since one of the faults to be found with many hog rations in this province is their high fibre and low energy values, resulting from the excessive use of oats, it was decided to test this product as a fattening hog feed. The findings here reported represent the results of the first comparative feeding test involving ten lots of eight pigs each, fed rations in which varying proportions of farm grains were replaced by rice feed.

EXPERIMENTAL

The pigs for this test were all purebred Yorkshires, weaned at about eight weeks and started on test between 60 and 70 days of age. They were allotted in sets of ten (i.e. a complete replicate set). Since all pigs were penned and fed individually, it was not necessary that sets of replicates start on trial at the same time. In addition to minor differences in date of starting, the complete test involved both spring and fall-born pigs, the first three replicates in all lots starting in April, while the remaining five replicates started the latter part of August.

The feeding period was subdivided into three parts. The first 42 days constituted the first period, during which the rations contained in each hundred 15 lb. of protein-mineral-supplement. At the end of this period

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the ration was changed to the finishing ration, the proportion of protein supplement being reduced from 15% to 10%. This second period continued for the next 63 days. The third period was of varying length for different pigs, being the time beyond the 105-day mark needed to bring the pigs individually to market weight of approximately 200 pounds. The ration used during the second period was continued through period three.

This plan made possible a standard 105-day feeding period on which to base relative rates of growth or live weight gain, and relative feed efficiency, and at the same time a measure of the variation in length of feeding period according to the different rations used.

In order to study the effect, if any, on the carcass, all pigs were slaughtered and their carcasses measured and graded on the same plan and by the same officials as are involved in the Federal Advanced Registry Feeding Tests for Swine. In addition, a cross-section of the bacon rasher was traced, from which data relative to the fat and lean distribution in the retail bacon were obtained.

The detail of the rations fed are shown in Table 1. The proportions of protein supplement given are for the first period. During the second period this fraction of all rations was reduced to 10% with a corresponding increase in the other ingredients.

TABLE 1.—MIXING FORMULAE FOR RATIONS FED

Feed	Lots									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Rice feed	—	21.0	42.0	64.0	21.0	21.0	42.0	42.0	64.0	64.0
Barley	42.5	32.0	21.5	10.5	64.0	—	43.0	—	21.0	—
Oats	42.5	32.0	21.5	10.5	—	64.0	—	43.0	—	21.0
Mixed protein supplement	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0

The protein supplement consisted of:

Tankage	50 (60% protein)	Alfalfa meal	10
Fish meal	15	Salt	5 (iodized .01%)
Linseed oilmeal	15	Bone char	5

The rations shown in Table 1 carried about 17%, while those of period two averaged 15% crude protein.

Feeding was done three times a day during the first period and twice a day thereafter. The dry meal allowance at each feeding was placed in the feed troughs and the water allowance poured over it. Pigs were full-fed throughout the trial.

OBSERVATIONS DURING THE TEST

One very noticeable feature of the test was the sleek and thrifty appearance of the pigs on the rations carrying 25% and 50% rice feed. Those on the maximum rice allowances did not develop this appearance. This was noticeable particularly during the first two months of the trial, and in many cases the pigs on rice made better gains than those of the

check lot. However, before market weight was reached, these pigs took their feed less well, and, taking the full period, it was evident that the rice rations were less well eaten than that of the check lot.

What may be the cause of this evident tiring of the ration after a period of heavy feeding is not revealed in this test. It would seem, however, that advantage might well be taken of the apparently high value of this feed during the growing period.

Another observation concerned the colour of fat of the carcasses, which in the heavy rice fed lots tended to be of a yellowish tinge. There was no evidence that this was detrimental, though it was usually found with the softer carcasses. It should also be mentioned that one pig in Lot IV died on the 89th day of the test. He had been doing poorly for some time previous, but no definite reason could be given for his condition. The data for this pig were deleted from the final results.

RESULTS

In Table 2 are summarized the results of this feeding test.

In this table certain items are of particular interest. One of the first concerns the gains and feed consumption. Considering only the lots in which rice feed replaced mixed barley and oats, the feed consumption dropped as the proportion of rice feed increased. The same tendency is noted in the lots involving barley or oats separately as well, but the effect is not particularly noticeable excepting in the highest rice groups. This evident lack of palatability and consequent reduction in feed intake was apparently the cause of the drop in gains, since the gains when corrected for differences in feed intake are very similar. In fact, in these cases the rice rations were slightly more efficient than the check lot. Statistical analysis indicates that, excepting Lot VI, there is probably not any surely significant difference in the efficiency of these rations in so far as gains per unit of food eaten is concerned.

The effect of the lower feed intake and the slower gains resulting therefrom in the rice-fed lots is clearly shown in the length of feeding period required to get the pigs to market weight. In fact, on the average one might calculate that each 5% increase in rice means a lengthening of the feeding period necessary to reach 200 pounds of about two days. This is not at all a matter of consequence in the lots in which 25% of the basal feed was rice, but means nearly a month extra feeding in the case of the lots receiving 75% rice feed.

In so far as the character or quality of the live hog at market weight was concerned, no difference can be claimed for any effect of feed. The distribution of the pigs among the lots follows no definite trend, and in the whole lot of 79 hogs going to slaughter there were 52% graded as select bacon, which is very close to expectancy.

Carcass score follows the proportion of rice in the ration. For each 10% addition of rice feed the carcass score drops three marks on a scale of 100. This effect is almost entirely chargeable to the high correlation which exists between softness of fat and the grade of the belly portion of the carcass, "belly grade" being one of the important items in carcass score.

TABLE 2.—SUMMARY OF COMPARATIVE FEEDING TEST OF RICE MEAL FOR SWINE (EXPERIMENT NO. 64)

—	Lot No.									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Rations { Barley / Oats / Rice meal } As percentage of basal feed mixture	50 50 —	37.5 37.5 25.0	25 25 50	12.5 12.5 75.0	75 — 25	— 75 25	50 — 50	— 50 50	25 — 75	— 25 75
Number pigs	8	8	8	7	8	8	8	8	8	8
Average initial weight	39	35	36	36	34	39	40	40	35	38
Average weight (105 days)	193	175	158	157	173	157	174	164	144	147
Average daily gain (105 days)	1.46	1.33	1.16	1.15	1.32	1.12	1.28	1.18	1.04	1.04
Feed consumed (42 days)	159	148	134	125	138	138	141	140	129	134
Feed consumed (105 days)	616	553	473	436	517	501	511	491	420	434
Gains in 42 days (corrected to initial weight of 37 lb. and feed intake of 138.5 lb.)	42	42	38	46	32	39	40	41	38	36
Gains in 105 days (corrected to initial weight of 37 lb. and feed intake of 495 lb.)	129	130	127	134	136	115	129	123	126	121
Average days to market weight	113	123	136	134	125	137	125	132	140	146
Average shipping weight	206	201	201	195	209	197	209	206	190	196
Grading of hogs on the hoof—No. Selects	3	5	2	1	7	2	6	8	5	2
Bacons	5	3	5	3	0	5	2	0	2	4
Butchers	0	0	1	3	1	1	0	0	1	2
Firmness of back fat (Number carcasses in each grade) —Firm	6	0	0	0	1	0	0	0	0	0
Medium	2	6	2	0	6	3	3	3	0	2
Soft	0	2	6	7	1	4	5	3	8	6
Carcass scores	70	66	47	53	66	53	61	60	45	47

Preliminary analysis of the carcass data indicates that there has been no effect of ration on the proportion of fat to lean of the bacon rashers. This finding is quite in line with expectation, inasmuch as the protein levels of all lots were practically the same, and pigs were all carried to about the same marketing weight. It is evident, therefore, that the slower rate of growth in some lots had no effect, detrimental or otherwise, on the quality of the bacon cut in so far as fat and lean is concerned. The percentage of lean varied from 38.3 to 43.0% with an average of close to 40%. Preliminary studies (Macdonald College, unpublished) have indicated that 40% lean in the bacon rasher is a very satisfactory proportion of lean, though no standards of excellence have thus far been established.

The relation between barley, oats, and mixed barley and oats is well shown in this test. In no comparable case did oats plus rice feed equal barley plus rice feed. In fact, barley plus rice produced slightly greater gains per unit of feed eaten than did mixed barley and oats plus rice in cases where rice did not exceed 50% of the ration. The carcasses of the barley groups were also better, all of which indicates that rice appears to supplement barley better than it does oats, and further, that oats probably dilutes rather than amplifies the feeding value of barley for market hogs.

The most striking effect of rice feed is shown in its effect on the softness of the back fat of the carcass. In this feature, Lot I was satisfactory, and Lots III and V could not be seriously discriminated against. Lot VI, however, in which 25% rice replaced a like amount of oats, and in all lots in which rice feed constituted 50% or more of the basal ration, too many soft carcasses resulted.

SUMMARY

From the results of this test it would appear that rice feed is a product which when properly used has considerable value for hogs, particularly for young growing pigs, where its high fat and low fibre are of special importance. Because of its tendency to produce soft carcasses when fed in excess, rations for fattening pigs should probably not contain over 25% of this feed. Larger allowances may also adversely affect feed consumption and hence reduce rate of gain on fattening pigs.

The possibility of correcting the tendency toward soft fat by a "hardening period" previous to marketing, thus taking advantage of the value of rice feed for the growing pig but avoiding its undesirable effects on carcass quality, would seem well worth investigating.

Barley would seem to be a more desirable feed with which to mix rice feed than oats.

ACKNOWLEDGMENT

The financial assistance which made this study possible was generously provided by the Mount Royal Rice Mills, Montreal, Quebec, whose interest and support are greatly appreciated.

Résumé

L'emploi de la farine de riz pour remplacer une partie des grains de la ferme dans la ration du porc. E. W. Crampton, Université McGill, Collège Macdonald, P.Q.

Les résultats de cette expérience donnent à croire que le riz bien employé a une valeur considérable pour les porcs, spécialement pour les jeunes porcs d'élève, à cause de sa richesse en matières grasses et de sa faible teneur en fibres. Comme le riz a une tendance à produire un lard mou lorsqu'il est donné en excès, les rations pour les porcs d'engrais ne devraient pas contenir plus de 25% de cet aliment. Une proportion plus forte pourrait aussi exercer un mauvais effet sur la consommation de nourriture et par conséquent ralentir l'engraissement. Il semble qu'il y aurait lieu de faire des recherches pour voir s'il serait possible de corriger la tendance à la formation du lard mou par une "période de durcissement" avant la vente, profitant ainsi de la valeur du riz pour les porcs d'élève tout en évitant ses mauvais effets sur la qualité du lard. Il semble également que l'orge soit une meilleure nourriture que l'avoine en mélange avec le riz.

A NEW RECORDING RAIN-GAUGE

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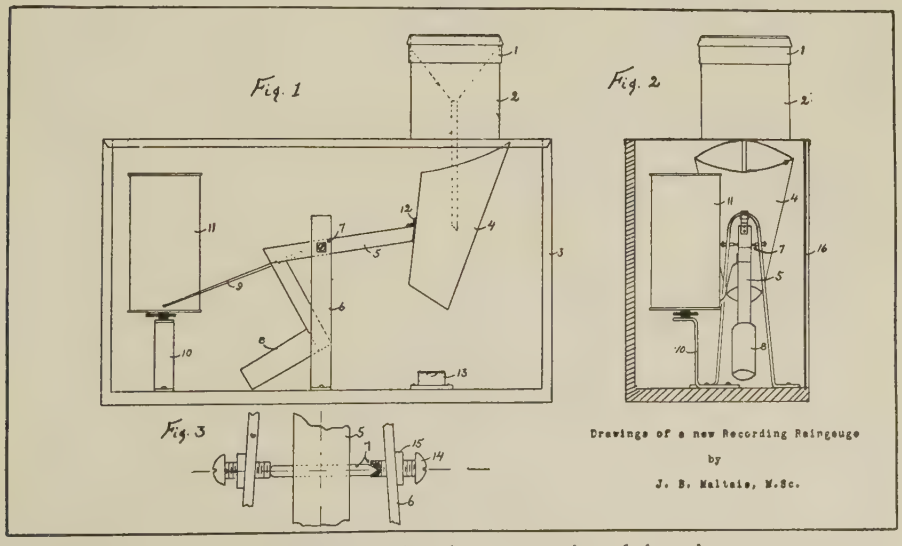
In addition to the known types of rain-gauges such as the ordinary field types, the recording siphon and float systems and the tipping bucket type with electric recording accessories, a new recording rain-gauge has been devised by the writer and carefully tested in 1935 at the Dominion Entomological Laboratory, Hemmingford, Que., Can.

The objects kept in mind in developing this device were as follows: first, to facilitate the continuous recording of rain or precipitation in inches and fractions of inch during a week on a chart which is divided in days and hours; second, to render the instrument simple in construction with the least wear for accurate, long and reliable service required in an apparatus of this type.

These objects are attained by the mechanism illustrated in the accompanying drawings in which:

Figure 1 shows a front elevation of the entire instrument.
Figure 2 is a side elevation of the same.
Figure 3 is a plan view of the detail of the suspension.
Figure 4 shows a front elevation of the recording balance at three equidistant positions.
Similar numbers refer to similar parts throughout the several views.

The complete instrument (Figure 1) consists of a rain-gauge funnel (1) measuring 5 inches in diameter; a funnel support (2) mounted on a galvanized iron cover of a wooden box (3); a water container (4); a balance arm (5) mounted on a support (6) by means of a needle point suspension (7); a rigid lead weight (8) which balances the water container (4); a recording arm and pen (9); a clock-cylinder support (10); a recording 8-day clock and cylinder (11); a water container hook (12); and a round level (13).



FIGURES 1 TO 3. Plan showing the construction of the rain-gauge.

[1] Junior Entomologist.

Figure 2 shows most of the parts mentioned above and particularly a glass side (16) which forms the front of the wooden box (3).

Figure 3 shows the detail of the needle point suspension (7) which consists of the needle (7) transversally set in the balance arm (5); of two set screws (14) mounted on the support (6) and held firmly in place by lock nuts (15). Each point of the needle (6) is set in a deep cavity made at the end of each set screw (14).

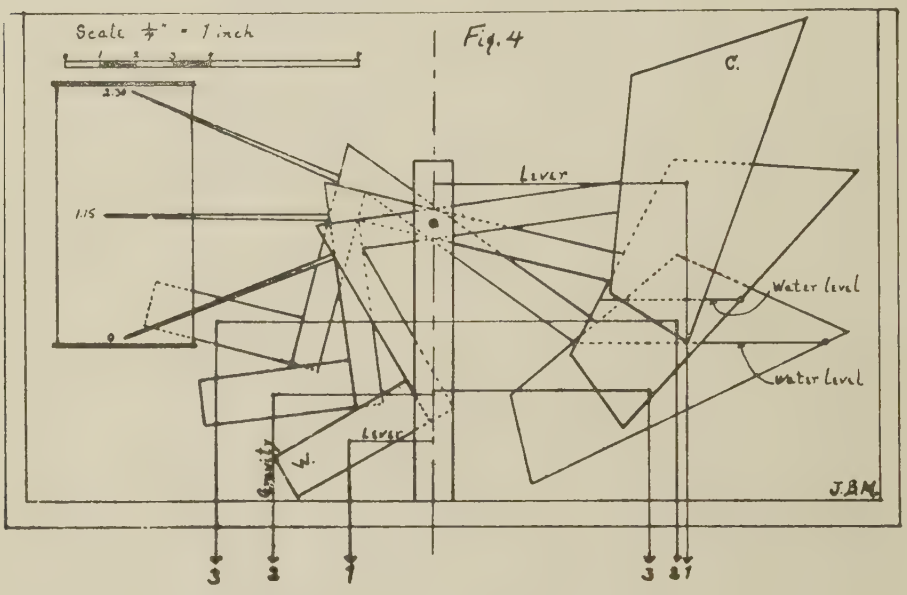


FIGURE 4. Plan showing the recording balance at three equidistant positions.

As the rain falls upon the open surface of the funnel (1) and the water gathers in container (4), the weight (8) is displaced gradually, carrying the registering pen over the surface of the paper chart on the cylinder (11).

The above drawings show that the water container (4) has a special shape and that it is also attached to the balance arm (5) at an angle of 75°. This is to correct the displacement of the weight (8) in relation to the water container (4) and to obtain a uniform scale on the chart. The round level (13) is required to set the instrument at proper level and is also needed to verify, at intervals, the exact level position.

In view of adding further details to the foregoing description, the following plan was prepared according to measurements at a scale of $\frac{1}{4}$-inch to the inch. The balance is shown on the plan at three different positions.

1. In equilibrium with the container (C) empty;

2. In equilibrium with the container (C) containing 12.9 ounces of water equivalent to 1.15 inches of precipitation;

3. In equilibrium with the container (C) containing 25.8 ounces of water equivalent to 2.30 inches of precipitation. The total weight of the balance on its pivot, when empty, is 48 ounces. The ratio of leverage between the weight (W) and the container (C) at the start is 1 to 3.

The equations which were worked out according to the above figures are as follows:

1. (Weight (W) × Lever) − (Container (C) × Lever) = 0 or equilibrium
or (36 ozs. × 2.25″) − (12 ozs. × 6.75″) = 0 or equilibrium

2. (Weight (W) × Lever) − (Container (C) + Water × Lever) = 0
or (36 ozs. × 4.50″) − (12 ozs. + 12.9 ozs. × 6.506″) = 0

3. (Weight (W) × Lever) − (Container (C) + Water × Lever) = 0
or (36 ozs. × 6.00″) − (12 ozs. + 25.8 ozs. × 5.71″) = 0

Thus, the container (C) is arranged in such a way that the accumulation of water automatically regulates the whole balance and yields uniform scale on the record chart as demonstrated by the three successive positions shown on the above plan.

Figures 5 and 6 show two different weekly records of rainfall obtained at Hemmingford, Que., with the original instrument. Each horizontal line on the chart represents one-tenth of an inch. The rain-gauge has a maximum recording capacity of 2.30 inches of rain per week.

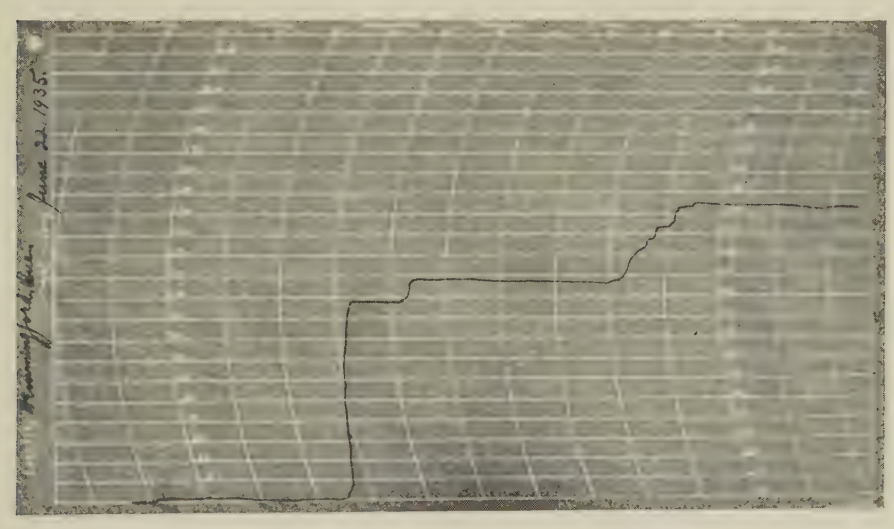


FIGURE 5. Record of rainfall for the week ending June 22, 1935.

Special inquiries concerning self-recording rain-gauges in use at the Meteorological Service of Canada at Toronto and the U.S. Weather Bureau at Washington indicate that the above described instrument is original in design and operation.

The said rain-gauge was completed in May, 1935, and was placed in an open field for recording precipitation every week until the second week of November. All the weekly records, which are kept at present at the Entomological Laboratory, Hemmingford, Que., show the exact amount of precipitation for each week the instrument was under test. The instrument has proven to be so accurate and convenient that we have adopted it as an essential part of our weather station equipment.

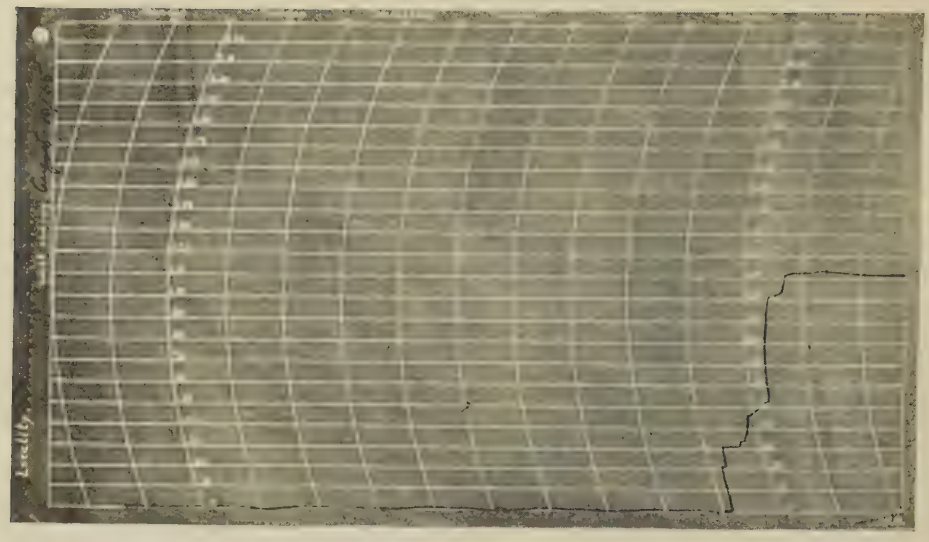


FIGURE 6. Record of rainfall for the week ending August 10, 1935.

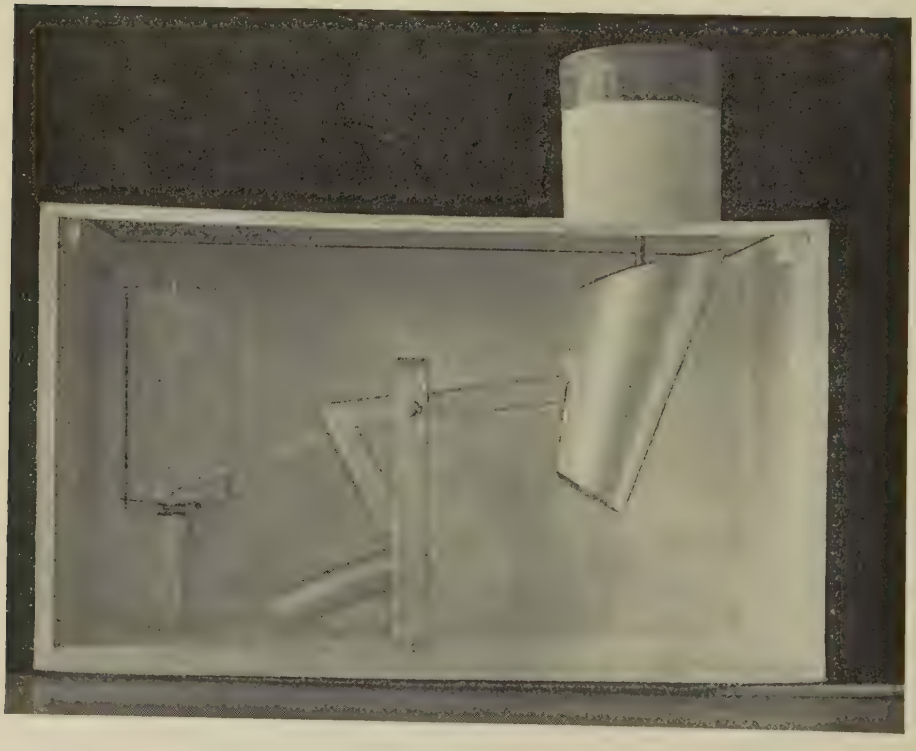


FIGURE 7. Photograph of the rain-gauge complete.

COMPOSITION OF SOME ALBERTA PEATS[1]

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Bog or "muskeg" in the wooded portions of the Canadian prairie provinces covers vast areas estimated at over twenty millions of acres. Little use has been made of these muskegs, and, as a preliminary to their eventual utilization, the composition of some Alberta peats has been investigated.

Alberta peats are for the most part comparatively raw and undecomposed. Many bogs have a depth of from two to three feet of light coloured, mossy peat; some have as much as six feet in which structure of the various plant residues is readily observed; the apparent specific gravity is low, and the cellulose content high (*2*). As a rule the upper layers are mossy and undecomposed; whereas the lower horizons are darker, more compact and of a more decomposed and granular nature. Alberta peats are formed chiefly by sphagnum moss. Another plant inhabiting these muskegs is *Ledum groenlandicum*.

In Table 1 the colour of samples varies from a light fawn to a dark brown and is designated light brown, medium brown, and dark brown. Degrees of decomposition are shown thus: not decomposed, slightly decomposed, semi-decomposed, and much or greatly decomposed. The apparent specific gravity is 0.15 for the top layer of Carnwood profile, 0.36 for the bottom horizon of Duffield, 0.40 for the second horizon of Spruce Grove, and only 0.06 for the top layer of Pickardville, as compared to an apparent specific gravity of approximately 1.0 for Edmonton black loam.

There is considerable variation in hydrogen ion concentration between different bogs and even within the same bog. The lower horizons are less acid than the upper ones in practically all cases. A general relationship between acidity and calcium content exists, but it is not absolute, probably owing to other factors such as biological activity resulting in varying production of organic acids; consequently some of our peats which are fairly high in calcium, test rather acid. In spite of the high calcium content of many samples very few showed the presence of free lime.

The variation in phosphorus content of Alberta peats is great. The only cultivated bog, that near Spruce Grove, has one of the highest percentages of phosphorus (0.123); most of the others have less than half this amount. Even between horizons of one profile there is often a striking difference. The top layer of the Vimy bog has less than a quarter as much phosphorus as the horizon immediately below it; also, the second layer at Nestow has over six times as much phosphorus as the top horizon.

Total nitrogen in Alberta peats is usually fairly high, though not quite as great, on the average, as that of peats in the United States and Western Europe. The more decomposed layers generally have the higher nitrogen content. For example in the Carnwood bog the semi-decomposed second horizon has double that of the undecomposed top layer. The lowest

[1] This paper was prepared from a thesis submitted to the University of Alberta in partial fulfilment of the requirements for the degree of M.Sc.

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TABLE 1.—DESCRIPTION AND ANALYSES OF SOME ALBERTA PEAT SOILS, TOGETHER WITH COMPARATIVE COMPOSITION OF OTHER SOILS

Profile location	Depth sample	Physical description	pH	Organic matter %	Ca %	P %	N %	K %
25, 49, 1 W. of 5th	0″–16″	Lt. brown, not decomp.	3.9	98.4	.89	.041	.61	—
	16″–30″	Lt. brown, sl. decomp.	4.2	95.7	1.51	.028	.71	—
	30″–45″	Med. brown, semi-decomp.	5.1	91.2	2.54	.035	1.73	.012
	45″–60″	Dark brown, much decomp.	5.6	90.5	2.01	.043	2.25	.021
	Below	Mineral loam	5.5	—	.83	—	.32	—
Carnwood	0″–24″	Lt. brown, not decomp.	4.3	98.1	1.06	.067	.82	.057
	24″–50″	Med. brown, semi-decomp.	4.7	94.4	2.46	.066	1.64	—
Genesee	0″–16″	Lt. brown, not decomp.	4.0	96.6	2.16	.055	.69	—
	Below	Med. brown, semi-decomp.	4.5	95.7	1.92	.024	.55	—
Duffield	0″–14″	Lt. brown, sl. decomp.	4.4	91.7	1.88	.062	1.65	.045
	14″–30″	Med. brown, sl. decomp.	4.5	93.3	2.70	.033	1.35	—
	Below	Med. brown, semi-decomp.	5.1	91.9	2.15	.038	2.90	.013
Carvel	0″–12″	Med. brown, sl. decomp.	6.1	86.9	4.30	.096	1.32	—
	12″–30″	Dark brown, semi-decomp.	6.2	86.7	4.50	.075	1.69	—
	Below	Lt. brown, sl. decomp.	6.2	88.1	4.25	.051	.95	—
Stony Plain (West)	0″–12″	Lt. brown, not decomp.	5.8	—	1.30	.075	.74	—
	12″–24″	Lt. brown, sl. decomp.	5.5	94.0	2.55	.046	1.04	.034
	24″–42″	Med. brown, semi-decomp.	5.6	91.0	4.40	.033	.96	.014
	42″–48″	Dark brown, much decomp.	5.7	86.0	5.55	.040	1.17	.023
Stony Plain (East)	0″– 6″	Lt. brown, sl. decomp.	7.1	70.0	2.50	.078	.96	.088
	6″–24″	Med. brown, semi-decomp.	7.1	88.0	5.90	.103	1.63	.024
	24″–48″	Dark brown, much decomp.	6.4	85.3	3.07	.086	2.23	.023
Winterburn	0″– 6″	Lt. brown, not decomp.	5.3	87.0	1.38	.083	1.14	.100
	6″–30″	Med. brown, sl. decomp.	6.4	93.5	3.12	.046	.91	—
	30″–42″	Dark brown, much decomp.	7.0	85.0	4.85	.073	1.86	—
	42″–48″	Mineral clay	7.3	—	—	—	.28	—
Spruce Grove	0″–14″	Dark brown, much decomp.	7.3	82.8	5.73	.123	1.92	.022
	14″–24″	Dark brown, much decomp.	6.4	79.8	6.67	.087	1.98	—
	Below	Mineral clay	7.3	—	—	—	.16	—
Vimy	0″–20″	Lt. brown, not decomp.	3.8	97.0	.76	.027	.46	—
	20″–34″	Dark brown, semi-decomp.	6.4	52.1	4.53	.110	1.14	.047
	34″–42″	Lt. brown, sl. decomp.	5.8	88.0	4.24	.015	1.20	.022
	42″–48″	Mineral clay	7.3	—	—	—	.31	—
Nestow	0″–20″	Lt. brown, sl. decomp.	4.5	89.2	1.32	.023	.76	—
	20″–24″	Med. brown, much decomp.	5.4	77.3	1.34	.149	1.54	.041
	Below	Gray fine sand	5.8	—	—	—	.04	—
Pickardville	0″–20″	Lt. brown, not decomp.	3.8	93.5	.66	.054	.62	—
	20″–50″	Lt. brown, sl. decomp.	4.4	92.0	.78	.030	.94	.069
	50″–60″	Med. brown, semi-decomp.	5.1	89.8	1.21	.044	2.28	.039

horizon of the Carvel profile is less decomposed than the layers above it, and thus one would expect the greater amount of nitrogen in the more decomposed upper layers, which is the case.

Values shown for the chief plant foods in the preceding table will be misleading unless apparent specific gravity of the peat is taken into consideration. Thus the top peat horizon at Carnwood, with an apparent

SOME COMPARATIVE ANALYSES

Profile location	Sample depth	pH	Organic matter %	Ca %	P %	N %	K %
Caledonia Springs peat near Ottawa, Ont. (4)	0″–8″	3.9	89.3	.34	.045	1.67	.020
	2′–3′	5.3	87.3	.95	.025	2.09	.036
	5′	6.0	86.6	.95	.025	2.69	.030
	6′–7′	6.8	80.9	1.93	.028	2.51	.050
Minnesota peat (1)	—	—	87.7	1.85	.109	2.70	.060
Minnesota peat (1)	—	—	94.0	.22	.070	1.70	.030
Fenn peat, Scotland (3)	—	—	—	2.50	.109	2.50	.100
Moor peat, Scotland (3)	—	—	—	.35	.044	1.20	.050
Edmonton black loam (5)	—	—	—	1.22	.108	.62	1.49
Alberta wooded soil (6)	0″– 2″	7.5	—	1.32	.164	.634	1.13
	3″–11″	6.6	—	.46	.065	.043	1.41

specific gravity of 0.15, contains on a weight basis .067% phosphorus, 0.82% nitrogen and 0.057% potassium; whereas Edmonton loam with an apparent specific gravity of approximately 1.0 contains 0.108% phosphorus, 0.62% nitrogen, and 1.49% potassium (*5*). On a volume basis Carnwood peat would have only about one seventh as much of these elements; that is, 0.010% phosphorus, 0.12% nitrogen and .008% potassium. Evidently the amount of these chief plant food elements within reach of an average root system is small in the peat by comparison with the Edmonton loam soil.

An outstanding feature of a comparison of Alberta peats with some others is the high average calcium content of the former. The nitrogen, and probably potassium content of the Alberta muskegs studied is lower, on the average, than that of peats representative of some other parts of Canada, the United States, and Scotland. The varying percentages of phosphorus in Alberta peats range both above and below those of other peat lands shown in the comparative analyses part of the table.

SUMMARY

A number of samples of Alberta peats in the vicinity of Edmonton were sampled according to profile layers and analysed chemically, as a preliminary to their eventual utilization. These analyses generally indicate low plant food reserves in Alberta "muskeg" lands.

Many of the peat samples were very rich in calcium, varying from .66 to 6.67% with the majority falling between 2 and 4%. The lower horizons were generally richer in calcium than the upper ones.

The surface horizons were generally acid, having in some cases pH values as low as 3.8. However in two of the profiles the surface horizons had pH values above 7. The lower horizons were in general less acid than the upper ones.

The total nitrogen in these peats varied from .46 to 2.90% with the majority of the samples falling within the range of from 1 to 2%. On the average, the nitrogen content of Alberta peats is probably not quite as great as that of peats in some other parts of Canada, the United States and Western Europe.

The phosphorus content of the Alberta peats was extremely variable, ranging from .02 to .12%. The potassium content was small ranging from .01 to .10%.

The chemical analysis of the peats investigated tends to bear out the wide variability in composition of such soils.

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Résumé

Composition de quelques tourbes de l'Alberta. K. H. Walker, Université d'Alberta, Edmonton, Alta.

Un certain nombre d'échantillons de différentes couches de tourbes dans le voisinage d'Edmonton ont été prélevés et analysés chimiquement, comme préliminaire à l'utilisation possible de ces tourbes. Ces analyses indiquent généralement que les tourbières de l'Alberta ne possèdent qu'une faible réserve de principes fertilisants. Beaucoup des échantillons étaient très riches en calcium; la proportion variait de .66% à 6.67%, tandis que la majorité se rangeait entre 2 et 4%. Les couches inférieures étaient généralement plus riches en calcium que les couches supérieures. Les couches de surface étaient généralement acides, ayant en certains cas une valeur de pH descendant jusqu'à 3.8. Cependant, dans deux profiles la valeur de pH dépassait 7. Les couches inférieures étaient généralement moins acides que les couches supérieures. La teneur totale en azote de ces tourbes variait entre .46 et 2.90% et la majorité des échantillons présentait une proportion de 1 à 2%. En moyenne, la proportion d'azote dans les tourbes de l'Alberta n'est peut-être pas aussi élevée que dans les tourbes des autres parties du Canada, des Etats-Unis et de l'Europe occidentale. La teneur en phosphore des tourbes de l'Alberta était extrêmement variable, allant de .02 à .12%. La teneur en potasse était faible, de .01 à .10%. L'analyse chimique des tourbes étudiées tend à confirmer l'opinion que la composition de ces sols est très variable.

BOOK REVIEWS

PLÖTZ, K.—Der Einfluss der Düngung auf den Pflanzenbestand des Dauergrünlandes (The influence of fertilizers on the herbage of permanent pastures.) Publ.: Verlagsgesellschaft für Ackerbau; Berlin—Germany. 1935; 79 pp.

This is a review of recent technical literature on the subject. Some 131 items are being critically analyzed for the purpose of showing the farmers something of the present day knowledge of the changes brought about by the use of manure or fertilizers on the botanical composition of permanent pastures. After a brief introduction, the effect of lime, stable manure, potash, cyanamide and nitrogenous fertilizers on the composition of pasture herbage is discussed. In the summary the author emphasizes that it has been shown that fertilizers do not only increase the yields, but also materially improve the albumen contents of the herbage. Apparently potassium phosphate deserves first rank in bringing about a profitable increase in yield as well as a general improvement in the quality of herbage.

The volume concludes with a valuable bibliography and a list of plant species referred to.

—H. T. Güssow

CHRONICA BOTANICA. An annual record of pure and applied botany, edited by Fr. Verdoon in collaboration with an advisory board and numerous assistants and corresponding editors. Publishing Office: P.O. Box 8, Leiden, Netherlands. Ann. Subscr., 15 Netherland Guilders. Vol. 1. 1935.

This is quite a volume; well bound, good printing and some 447 pages in size. It is intended to bring each year a review of the important current researches in all branches of plant science throughout the world. A very ambitious program to be sure! Indeed in its conception it is ideal—"Whether you be director, research worker, professor, specialist, collector or teacher, 'Chronica Botanica' will answer hundreds of questions [we all hope correctly! (Reviewer)] previously left unanswered, although they often were of fundamental importance for the continued progress of your work." So we are informed by the editor.

Let us look at some Canadian Botanists and the account of their activities in this first volume before us. Buller, A. H. Reginald Buller—whom every one knows, not only in Canada, but throughout the world. We are told he was president of the section MYC. of the VI Intern. Botan. Congress at Amsterdam, we next find his name mentioned in connection with another eminent Canadian mycologist, John Dearness, "a consultant of Dr. Buller in his recent publication on fungi." Then under Winnipeg we have a fair account of his most recent work and of honours conferred upon him during the year. Under the section Canada the first name is that of C. E. Saunders, "who has been knighted." Agassiz, the next entry, is in "Col." (B.C.?). I am afraid the editor is not very familiar with Canadian Geography. It is just a little unclear and I hope will all be remedied in the next volume. The matter might be arranged more suitably by Provinces.

Under Ottawa the biology dept. of the University of Ottawa—this and nothing more—heads the list. The Seed branch of the Dom. Dept. Agriculture is referred to "by title"—and so is the National Herbarium of Canada, viz: c/o. Nat. Museum (!). These few examples are indicated to stimulate contributors from Canada to take the trouble to supply correct information, and the editor by having his attention directed to room for improvement. Let the next issue help us to form an opinion as to whether the ambitious programme is likely to be realized.

—H. T. Güssow.

OBSERVATIONS SUR L'INFLUENCE DE L'ALIMENTATION DANS LA PRODUCTION D'UN LAIT DE BONNE QUALITÉ INDUSTRIELLE

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[Reçu pour publication le 15 février 1936]

L'alimentation rationnelle des vaches laitières exerce une influence prépondérante tant sur la production quantitative que sur la production qualitative du lait destiné à des utilisations industrielles.

La valeur ou la qualité industrielle d'un lait peut s'exprimer par l'ensemble des propriétés et des caractéristiques physico-chimiques, biologiques et organoleptiques requises pour assurer la fabrication de produits laitiers de haute valeur commerciale. Pour donner une idée de la perfection industrielle pouvant être obtenue dans le domaine pratique, nous pouvons citer le beurre danois, les fromages suisses et français et autres produits laitiers de renommée mondiale. Nous pouvons avancer également que ces perfectionnements ont été rendus possibles par les progrès de la chimie et de la bactériologie du lait, par les soins apportés à la production et à la manipulation du lait, par l'amélioration des techniques de fabrication, par l'orientation rationnelle de l'alimentation des vaches laitières en vue de la production d'un lait de qualité supérieure et, en dernier lieu, par l'application judicieuse de certaines méthodes de fertilisation et de conservation des récoltes.

Dans cet article, nous étudierons les questions relatives à l'amélioration de la qualité du lait et de ses produits dérivés par l'alimentation et par certaines méthodes de fertilisation et de conservation des récoltes, en mettant surtout en évidence les points suivants: l'*influence des aliments sur la qualité du lait;* les *recherches faites* et surtout les *constatations pratiques établies* après plus de cinquante années d'expériences dans les instituts d'expérimentation, dans les centres industriels laitiers et dans les associations coopératives laitières de Suisse, de France, d'Allemagne, du Danemark et des Etats-Unis; l'*étude du règlement de production laitière* paraissant le mieux connu et le plus solidement établi: *le Règlement suisse*, lequel a été utilisé dans bon nombre de pays après adaptation préalable à leurs conditions particulières.

Dans la dernière partie de cet article, nous soumettons à l'attention des experts canadiens en sciences agricole et laitière, quelques considérations générales susceptibles d'être appliquées ou adaptées à nos conditions de production laitière.

Sur ce point, nous croyons qu'il serait opportun et avantageux, tant pour le producteur que pour l'industriel et le consommateur, d'apporter quelques modifications à nos systèmes d'alimentation des vaches laitières, si l'on désire améliorer la qualité de notre beurre et rendre possible la fabrication au Canada de quelques fromages de qualité, importés jusqu'à date de l'étranger. Il conviendrait de rappeler ici que la production de lait de

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qualité supérieure contribuera non seulement à améliorer notre industrie fromagère, mais sera en plus le meilleur moyen d'encourager la consommation du lait et de ses dérivés.

Actuellement, nous n'avons pas encore de méthodes bien définies d'alimentation en vue de la production d'un lait de qualité industrielle. Néanmoins, à l'aide des données scientifiques et surtout des constatations pratiques obtenues jusqu'à date, nous pouvons cependant envisager la possibilité d'énoncer quelques principes d'alimentation qualitative, préconisant le rejet de quelques aliments pouvant exercer une influence défavorable sur le lait et ses produits transformés, et comme considération secondaire, si possible, la modification de quelques pratiques de fertilisation et de conservation des récoltes.

Le problème, tel que présenté au Canada, se résumerait à l'étude de la production du lait destiné à la consommation en nature et surtout à celle du lait destiné à la beurrerie ou à la fromagerie.

Dans le premier cas, les prescriptions alimentaires ou autres, sont plutôt limitées et assez facilement réalisables. En effet, pour obtenir un lait répondant bien, sur ce point, aux exigences sanitaires et industrielles, il suffit que ce lait soit de composition normale et exempt de microbes pathogènes et d'odeurs anormales. Les principales considérations nécessaires pour atteindre ce but, seraient les suivantes:

Pour obtenir un lait de composition normale, il faut attacher une importance très grande au contrôle sanitaire de l'animal. Par exemple, la recherche et le traitement de la mammite ou de toutes autres maladies pouvant provoquer des altérations importantes dans la composition du lait en plus de causer un tort considérable à l'animal affecté.

En ce qui regarde la prévention des microbes pathogènes, il y a lieu de considérer l'application des règles élémentaires de l'hygiène, prévues dans les règlements de l'industrie laitière. Nous pouvons ajouter que, dans la préparation industrielle du lait de consommation directe, la pasteurisation diminue de beaucoup les dangers de contamination bactérienne pathologique.

Pour la prévention d'odeurs et de goûts anormaux, il faut éviter le séjour du lait dans l'étable, ainsi que la proximité de certains produits (gazoline, pétrole, peintures, etc.) en plus d'éviter l'ingestion par l'animal d'aliments pouvant conférer au lait des saveurs ou des odeurs particulières.

Ici, nous pouvons signaler avec plaisir les progrès considérables réalisés depuis une quinzaine d'années, grâce aux enseignements et recommandations des experts en agriculture et en laiterie. Nous pouvons dire que, dans les conditions présentes, nous pourrions obtenir un lait de consommation en nature de toute première qualité si les règlements des villes étaient observés intégralement dans la pratique. Malheureusement, tel n'est pas toujours le cas et nous pouvons alors estimer comme satisfaisantes les conditions actuelles de production, en autant que le lait produit sera utilisé pour la consommation directe et si possible, après pasteurisation.

Dans le cas de la production de lait destiné à la beurrerie ou à la fromagerie, les prescriptions sont beaucoup plus nombreuses et d'application économique relativement difficile. Car, en plus de requérir l'application de considérations d'ordre spécial: contrôle sanitaire des établissements

et des animaux, etc.....la production efficace de ce lait demande également l'application de plusieurs considérations d'ordre plutôt général: influences qualitatives des aliments, de certaines pratiques d'alimentation et même de fertilisation des récoltes sur les caractères organoleptiques du lait.

Ceci revient à dire que, pour la réalisation de ces exigences, nous devons chercher à obtenir un lait possédant une constitution physico-chimique normale, une flore bactérienne essentiellement lactique (dans la mesure du possible naturellement) et des caractères organoleptiques normaux; et que toute altération dans ces qualités se traduira presque inévitablement par l'obtention de produits de valeur marchande réduite; dans certains cas, même la pasteurisation ne pourra compenser que dans une mesure limitée l'influence de ces altérations.

Dans la pratique, les principaux facteurs à considérer pour obtenir le moins d'altérations possibles de ces caractères sont: l'application de méthodes sanitaires dans la production et la prescription d'une alimentation bien en rapport avec les fins industrielles proposées. Sur ce point, nous préconisons tout d'abord l'étude des possibilités de rendre certains aliments plus hygiéniques par des modifications des méthodes culturales et de conservation et comme deuxième mesure, le rejet définitif de tout aliment non susceptible d'amélioration et pouvant causer des altérations sérieuses sur la qualité des produits laitiers.

Au sujet des précautions sanitaires à apporter dans la production du lait, il s'est fait beaucoup de travail pratique, dans ce sens, dans la province de Québec, si nous considérons les règlements des villes de Montréal et de Québec par exemple, en plus des lois prévues par le département de l'industrie laitière.

Ici, nous pouvons signaler que les techniciens du ministère provincial de l'agriculture apportent une attention toute particulière à une maladie qui cause d'énormes dommages aux vaches laitières et qui produit également des altérations prononcées dans le lait et surtout dans les fromages: *la mammite.* Dans presque tous les pays, on attache une importance de plus en plus grande à cette maladie, non seulement au point de vue économique et sanitaire, mais spécialement en raison de la dépréciation qu'elle cause à la valeur industrielle du lait. Il faut se rappeler que l'infection mammiteuse (streptococcique et micrococcique ordinaire), *avant même qu'elle ne présente des signes extérieurs perceptibles à l'exploration clinique vétérinaire* (*adspection et palpation*), produit des altérations chimiques et biologiques considérables sur la qualité du liquide élaboré: le lait. Le lait provenant de vaches mammiteuses donne toujours un caillé à fromage tout à fait anormal (dû à une diminution du lactose, de la caséine, etc., et à une augmentation notable en chlorure de sodium). De plus, il suffit souvent qu'un lait mélangé contienne 10 à 15% de lait de vaches mammiteuses pour le rendre inapte aux utilisations industrielles. Pour déceler cette maladie, les épreuves biologiques et chimiques permettent de découvrir les cas d'infection dans un pourcentage plus considérable que l'exploration physique (adspection et palpation). C'est un fait qui a été confirmé dans tous les instituts d'expérimentation de France, de Suisse, d'Allemagne etc. . . où les travaux les plus importants sur la mammite ont été réalisés. Nous pouvons dire qu'on n'attachera jamais trop d'importance à la recherche et au traitement de cette maladie.

Quant à l'influence de l'alimentation sur les qualités industrielles du lait, nous allons exposer tout d'abord les résultats de quelques expériences poursuivies sur cette question, sans trop les commenter. Cependant, nous verrons à la suite comment les pays où l'industrie laitière est très développée ont mis en pratique les conclusions obtenues dans ces travaux.

Afin d'en faciliter l'exposé, nous avons subdivisé le sujet de la façon suivante:

A. Observations sur les influences des aliments sur la qualité du lait.
B. Observations sur les influences des aliments sur le beurre: 1. Sur la texture du beurre. 2. Sur la qualité du beurre.
C. Observations sur les influences des aliments sur le fromage.

A. Observations sur les influences des aliments sur la qualité du lait

L'alimentation constitue sans contredit une des plus importantes portes d'entrée, dans le lait, d'éléments qui ne devraient pas s'y rencontrer. En effet, depuis fort longtemps, on rattache à l'alimentation des vaches laitières un grand nombre d'anomalies dans le goût et l'odeur du lait. Il y a dans cette assertion une grande part de vérité. C'est ce que nous allons démontrer dans ce qui suit:

D'après des expériences connues de tous, nous savons que les plantes suivantes altèrent le goût et la saveur du lait : ail, ciboulette, poireau, armoise (saveur âcre et brûlante); raves (odeur sulfurée); euphorbe ou rhubarbe des pauvres (saveur et odeur désagréables et âcres); chicorée, paille moisie, navet, lupin (goût amer); trèfle et en général les légumineuses (goût et odeur de vaches ou de fourrages); collets de betterave (goût et odeur de pourri); pommes de terre germées (goût amer et désagréable); maïs (odeur et saveur fades); plantes bulbeuses à odeur forte (goût âcre et nauséabond); betterave et pulpes de betterave fraîches (goût de poisson); pulpes de betteraves fermentées (goût et odeur d'acide butyrique—goût toxique); les crucifères telles que chou, navet, etc. . . donnant le goût de la plante correspondante ou parfois le goût de moutarde. Selon les publications de Pien et Herschdoerfer (*29*) les goûts conférés au lait par les crucifères sont toxiques.

Ces mêmes auteurs (comme plusieurs autres d'ailleurs) font cependant quelques réserves au sujet des légumineuses dont les inconvénients sont assez faibles; ils recommandent en plus, la constitution d'une ration à base de tourteaux (autres que ceux de crucifères), de grains concassés, de son, d'avoine, de fourrages divers, de carotte, de pois, de pommes de terre ainsi que l'usage de pulpes desséchées.

Dans presque tous les pays, il s'est fait un grand nombre de travaux élaborés sur ces questions et les conclusions obtenues se confirment l'une par l'autre. Il nous est impossible de citer toutes les expériences faites dans ce domaine, mais nous citerons quelques expériences relatées dans la littérature la plus accessible à notre continent.

Hunziker (*31*) rapporte que l'introduction dans la ration d'aliments mal conservés : foins, pailles, ensilage et grains moisis, drèches de distillerie en fermentation ou mal conservées etc. . . confèrent au lait et à ses dérivés des propriétés tout à fait indésirables, en plus d'altérer la santé de l'animal.

Babcock (*6*) dans ses expériences, arrive aux conclusions suivantes: le blé d'Inde vert, la plupart des concentrés vendus dans le commerce ainsi que quelques foins (du groupe des paturins du Canada, du Kentucky et de Virginie) n'ont aucune mauvaise influence sur la saveur et l'arôme du lait. Par contre, il a énoncé les observations suivantes : *a*) l'ingestion de 30 livres de luzerne verte par vache, une heure avant la traite, produit dans le lait une saveur très prononcée. Cette constatation a été confirmée par Lucas (*16*) et par Weaver, Kuhlman et Fouts (*24*).—*b*) le navet (*7*) donné à l'animal une heure avant la traite, produit des odeurs répréhensibles dans le lait.—*c*) l'ingestion d'oignon et autres plantes bulbeuses analogues (*8*) se traduit, dès une minute après l'ingestion, par l'apparition du goût correspondant dans le lait; ce goût est encore apparent après 4 heures et il disparaît si la traite est faite sept heures après l'ingestion.—*d*) un bidon de crème (*14*) possédant une saveur d'oignon assez prononcée peut communiquer cette saveur à un bassin entier de crème.

Dice (*12*) dans ses expériences sur le mélilot, a obtenu des résultats semblables à ceux de Babcock sur la luzerne.

Roadhouse et Koestler (*17*) ont démontré que le trèfle vert, ingéré moins de 5 heures avant la traite, provoque dans le lait une odeur anormale de vaches ou de fourrages.

Rosengren (*13*) a confirmé ces inconvénients du trèfle, en plus de les attribuer en général aux légumineuses. D'après d'autres expériences, nous pouvons dire cependant que les inconvénients dus aux légumineuses disparaissent si la traite est faite assez longtemps après l'ingestion ou si le lait est pasteurisé et aéré.

Dorner (*25*) a démontré que les prairies artificielles à base de légumineuses communiquent au lait cette odeur particulière et qu'en revanche, il n'en est rien dans le cas de pâturage sur prairies naturelles à graminées dominantes.

Selon Leroy (*10*) les plantes contenant des produits ou principes toxiques—des alcaloides surtout—telles que les renoncules, les colchiques, la ciguë, les prêles (celles-ci sont fréquentes dans les prairies humides) etc. . . sont dangereuses pour la santé de l'animal et pour la qualité du lait. L'auteur recommande alors de se méfier de la végétation poussant sur les levées de fossés et les prairies infestées de mauvaises herbes, et il préconise à cet effet, le drainage, les hersages ainsi que le chaulage. Il recommande en plus d'éviter l'ingestion par les vaches d'aliments ayant subi la fermentation butyrique ou ne paraissant pas dans un bon état de conservation.

Sur la betterave et ses produits dérivés, Post (*18*) a fait des travaux très intéressants et dans lesquels, il attribue les mauvais goûts produits par la betterave et ses produits, à la présence de bétaine ou triméthylglycocolle dans la betterave. Ce produit se transforme dans l'organisme même de l'animal (ou même avant si la betterave a subi une altération) en composés aminés tels que la triméthylamine, à odeur et saveur très désagréables. Il ne serait donc pas nécessaire, d'après cet auteur, d'invoquer la fermentation éventuelle de la betterave pour expliquer les mauvais goûts qu'elle est régulièrement capable de communiquer au lait. Comme autre observation de cet auteur, les pulpes de betteraves ensilées sans précautions

spéciales sont une cause certaine de mauvais goûts, non seulement à cause de la triméthylamine mais aussi à cause de l'acide butyrique si abondant dans les produits ensilés.

De nombreux médecins ont apporté la preuve irréfutable que les diarrhées infantiles d'automne et d'hiver (*29*) ont bien pour cause une mauvaise alimentation des vaches laitières (alimentation par betteraves, choux et certaines plantes citées plus haut). En particulier, Pinard (*26*) attribue principalement ces accidents à la betterave et aux pulpes de betterave fermentées. On ne dit pas cependant, si ces altérations peuvent persister après la pasteurisation du lait.

Comme considérations générales sur les crucifères, nous pouvons ajouter que ces plantes contiennent un glucoside susceptible de libérer, sous des influences diverses mais surtout bactériennes, du sulfocyanure ou thyocyanate d'allyle ou principe actif de l'essence de moutarde : facteur essentiel de certains mauvais goûts qui sont appelés goût de chou ou parfois goût de moutarde.

Orla-Jensen (*9*) a démontré en 1925, que ce glucoside ne donne par lui-même aucun mauvais goût au lait. Avec les aliments frais, le mauvais goût n'apparaît que sous l'action de certaines bactéries provenant de l'eau, du fumier etc. . .; elles agissent alors sur le glucoside éliminé dans le lait par l'animal.

Notons en passant que le sulfocyanure d'allyle n'est pas seulement la cause de mauvais goûts et de saveurs désagréables, mais il est également la cause d'accidents intestinaux graves chez les nourrissons (*29*) en raison de sa toxicité. Pour des considérations citées plus haut, il serait peut–être bon de l'interdire complètement, en éliminant les quelques crucifères de la ration de l'animal.

Il est bon de rappeler ici que la plupart de ces odeurs et de ces saveurs se retrouveront dans la crème, le beurre et les fromages dans le cas d'utilisation industrielle de ce lait, surtout dans le cas de fabrication avec produits crus (non-pasteurisés).

En plus des plantes utilisées régulièrement dans l'alimentation et susceptibles de conférer au lait des goûts et odeurs anormales, il faut compter aussi avec quelques mauvaises herbes et sur la contamination bactérienne de certains aliments.

Parmi les mauvaises herbes nuisibles dans ce domaine, nous pouvons inscrire sans hésitation les plantes suivantes : l'ail, l'oignon, le poireau, l'armoise, le tabouret des champs, l'herbe à poux, etc. . Toutes ces mauvaises herbes, même lorsque ingérées en petites quantités (une demi-livre environ) communiqueront au lait et surtout à la crème des odeurs tout à fait répréhensibles et très difficiles à enlever. Généralement, dans les laiteries, on retourne à l'expéditeur tout produit laitier présentant ces saveurs. Advenant leur transformation en beurre, ce dernier obtiendra moins de 88 pour cent des points alloués et sera classé automatiquement comme un beurre de quatrième qualité. Pour enlever ces odeurs, il faut avoir recours à une aération ou dégazéification intense de ces produits, laquelle est réalisée dans un bon nombre d'appareils commerciaux destinés à cette fin. Ces appareils, de même que la pasteurisation et l'aération ordinaire, enlèveront en même temps toutes les odeurs moins intenses (celles occasionnées par les légumineuses, etc. . .)

Comme mesure préventive, on recommande aux producteurs de lait de surveiller les heures d'alimentation et de traite. Par exemple, dans le cas de pacage des vaches, celles-ci seraient ramenées à l'étable le soir, de là, le lait de la traite du matin serait exempt des odeurs d'aliments. En plus, il faudrait ramener les vaches de trois à cinq heures avant la traite du soir. Cette mesure peut convenir assez bien aux producteurs importants, mais pour le fermier ordinaire elle n'est pas précisément économique. Le meilleur moyen de se débarrasser des odeurs dues aux mauvaises herbes, serait de détruire celles-ci par des pratiques culturales.

D'après les expériences précitées, il serait à recommander fortement, si on désire supprimer les odeurs anormales dans le lait, d'éviter l'introduction dans la ration d'aliments mal conservés (gelés, moisis, fermentés, etc.) ou d'aliments pouvant provoquer des troubles sérieux (quelques crucifères) et de prendre les mesures nécessaires pour détruire les plantes nuisibles (surtout les mauvaises herbes) et si possible, de surveiller les heures d'alimentation et de la traite.

En plus des goûts anormaux produits par plusieurs aliments, nous pouvons en attribuer quelques-uns à des microorganismes qui, en raison de leur présence régulière sur ces aliments, ont acquis des propriétés plus ou moins phéno-typiques de produire dans le lait, le beurre et le fromage, des substances de métabolisme de goût et d'odeur semblables à ceux conférés par les plantes sur lesquels ils végètent, comme exemple: goût de savon, goût de rance, goût amer, goût de poisson, goût de malt et même parfois des goûts aromatiques (*19*). Dans le cas d'infection du lait par ces microorganismes, si la pasteurisation du lait est faite assez tôt, on n'aura pas de mauvaises répercussions sur le produit.

Les mesures ci-haut précitées seraient suffisantes, en général, pour obtenir un lait sans saveur ou odeur anormale, mais nous devons ajouter aussi que l'exemption de saveur ou d'odeur particulière dans le lait, ne suffit pas toujours à la production de produits laitiers de haute qualité. En effet, quelques aliments, tout en altérant très peu les caractères organoleptiques du lait, contribueront cependant à en réduire les qualités beurrières et fromagères. C'est d'ailleurs ce que nous tenterons d'exposer dans le résumé suivant.

B. Observations sur les influences des aliments sur le beurre.

1. Sur la texture du beurre.

Les principales recherches faites sur ce point, furent réalisées en Allemagne et dans les pays scandinaves. Nous pouvons citer en particulier, les travaux exécutés à l'Institut prussien de recherches laitières (Kiel, Allemagne) où l'on a publié des tableaux indiquant les variations de l'indice d'iode (mesure d'appréciation de la qualité et de la texture du beurre) après des essais très élaborés sur à peu près tous les types d'aliments et de rations utilisables.

Dans la suite, de nombreuses expériences ont été poursuivies dans à peu près tous les pays intéressés dans la production du beurre et les conclusions générales de ces travaux peuvent être résumées de la façon suivante:

L'alimentation s'est révélée comme un des facteurs les plus décisifs affectant la composition chimique, le point de fusion ou la texture de la matière grasse du lait et par là, le barattage de la crème (crème douce surtout)

et finalement le malaxage du beurre. Nous pouvons dire que les aliments augmentant le pourcentage d'oléine dans le gras du lait produisent un beurre mou; dans cette classe, nous pouvons inscrire les aliments suivants: tourteaux de lin riches en gras, tourteaux de soja, moulées de gluten riches en gras, paturins du Canada et du Kentucky, gluten de maïs, avoine, son de blé, fourrages verts, le soleil, etc. . . Par contre, les aliments diminuant le pourcentage d'oléine exerceraient une influence contraire : production de beurre trop ferme et trop dur. Dans cette dernière catégorie, on peut inscrire en général, les aliments riches en sucres et en hydrates de carbone tels que: pommes de terre, blé d'Inde, ensilage de maïs, les betteraves, les tourteaux de coton, les foins, la luzerne, etc. . .

Leroy (*10*) classe les aliments au point de vue de leur influence sur la texture du beurre, selon la même base. Dans la première catégorie, il inscrit les aliments donnant des beurres à point de fusion peu élevé et fournissant des produits de qualité en hiver et trop mous en été, comme exemple, les aliments augmentant le pourcentage d'oléine dans le gras du lait. Dans l'autre, il fait rentrer les aliments donnant des beurres à point de fusion élevé, donnant des produits de bonne qualité en été, mais beaucoup trop durs en hiver et comme exemple, les aliments diminuant le pourcentage d'oléine. D'après le même auteur, les régimes alimentaires courants (à base de fourrages verts en été et d'ensilages et de pulpes de betterave en hiver) ont tendance à donner des beurres dont la qualité commerciale n'est pas en rapport avec la saison et il convient de modifier les propriétés spécifiques de ces régimes par l'addition de concentrés appropriés. Pour l'été, il serait préférable d'ajouter des tourteaux de coton à la ration et pour l'hiver, si on ne veut avoir de beurres trop durs, l'on se servira de tourteaux de lin et de son de blé.

Parmi les expériences faites sur le continent américain, nous pouvons citer celles d'Hunziker, Spitzer et Mills (*1*) lesquelles confirment les faits énoncés plus haut; celles de Keith, Kuhlman, Weaver et Gallup (*30*) qui ont démontré que l'usage de tourteaux de coton (dans une proportion assez élevés dans la ration) augmentait le % de stéarine dans le gras du lait; ce qui se traduisait par un barattage plus long de la crème et un malaxage du beurre plus difficile.

2. Influences des aliments sur la qualité du beurre.

Sur ce point, malgré le grand nombre d'observations pratiques, nous pouvons citer seulement quelques expériences accessibles à la littérature du continent américain. Ces expériences concernent plutôt les ensilages, les betteraves fourragères et demi-sucrières, les aliments mal conservés etc. . que les autres aliments utilisés régulièrement dans la ration.

D'après Eichstadt et Dibbern (*15*) certains aliments non-susceptibles de provoquer par eux-mêmes l'apparition de mauvaises saveurs, ou odeurs dans le lait, peuvent cependant exercer des actions défavorables sur le beurre.

Paci (*23*) démontre que les betteraves développent une action défavorable tant sur le rendement que sur les caractères organoleptiques du beurre, bien qu'il soit constaté que ce produit n'altère pas trop la saveur du lait lorsque donné à l'animal immédiatement après la traite. Selon le même auteur les fourrages ensilés et à un moindre degré les betteraves

peuvent altérer la prédisposition fermentative du lait jusqu'à le rendre inapte aux utilisations industrielles (transformation en beurre ou en fromage.)

D'après Savini (*20*) l'alimentation avec l'ensilage fait augmenter l'acidité du lait et entraîne en plus des variations dans sa valeur cryoscopique; laquelle est une des rares valeurs constantes de la composition du lait. Ceci démontrerait que l'équilibre physico-chimique du lait subit des altérations et prouverait en même temps l'influence des aliments ci-haut nommés. Comme influences directes sur le beurre, Savini décrit des altérations légères des caractères organoleptiques, mais il prétend que ni l'ensilage ni les betteraves ne conduisent à un produit très modifié au début; surtout, si dans la récolte du lait et dans la fabrication, on a suivi des méthodes rationnelles. Le beurre obtenu dans ces circonstances ne sera pas des plus parfumés mais il n'aura pas non plus—dans les quelques jours suivant la fabrication—de saveurs répugnantes. Mais, selon l'auteur, l'influence de l'ensilage et de la betterave se ferait sentir dans la *conservation du beurre* et à cela, s'ajouterait une altération plus importante: l'apparition de la saveur huileuse.

Les expériences de Hesselberg (*11*) montent également qu'une des causes du goût huileux dans le beurre serait à rechercher dans la betterave apportée dans l'alimentation des vaches laitières.

D'après les autres travaux publiés sur ces questions, nous pouvons dire que l'action des ensilages et des fourrages mal conservés etc. . . se manifesterait plus ou moins longtemps après la fabrication, par la présence de goûts et d'odeurs variés et l'apparition de quelques défauts courants.

La meilleure preuve que nous puissions apporter à ces avancés, c'est qu'en plusieurs pays, on permet l'usage de l'ensilage et des betteraves dans la ration lorsque le lait est destiné *uniquement* et *sans interruption* à la consommation directe, et que ces produits sont formellement interdits dans le cas de production du lait destiné à toute transformation industrielle.

Sur ce point, il serait très intéressant et utile qu'il se poursuive des expériences au Canada, pour déterminer exactement les influences des aliments sur les caractères organoleptiques et sur la conservation du beurre. Actuellement, nous nous basons surtout sur ce qui est admis dans tous les pays s'occupant de la production intensive de beurre de bonne qualité.

C. Observations sur les influences des aliments sur la qualité du fromage

Il s'est fait sur cette question un grand nombre de publications et de travaux. La majeure partie des conclusions que l'on peut énoncer sur ce sujet serait le résultat de l'expérience pratique de plusieurs générations de fromagers de tous les pays d'Europe et des expériences systématiques faites surtout en Allemagne, en Suisse et en Italie. Nous relaterons tout d'abord quelques observations pratiques et finalement quelques expériences systématiques.

Il résulte (*21*) des recherches les plus récentes sur la composition chimique et sur les phénomènes biologiques du lait, que nous sommes encore bien loin de connaître tous les facteurs qui donnent au lait ses qualités

fromagères. On peut cependant très bien concevoir que les modifications de tel ou tel fourrage, dues à une mauvaise conservation ou à une mauvaise préparation ou encore, à un changement de fumure (applications de purin sur les herbes à pâturages) puissent changer les propriétés chimiques et bactériologiques du lait au point d'affecter la composition et la fermentation du fromage.

Nous sommes un peu mieux renseignés sur l'influence de certains fourrages (*21*) sur les qualités fromagères du lait. Nous savons par exemple, que *le fourrage ensilé ne se prête absolument pas à la production de lait de fromagerie* parce qu'il l'infecte de bacilles butyriques. On sait également, que *l'emploi intensif de tourteaux oléagineux* cause une fermentation du lait qui provoque le gonflement sous presse et donne mauvais goût au fromage. En employant des *fourrages inappropriés qui provoquent particulièrement la diarrhée chez les animaux*, ou en fourrageant des farines, on infecte facilement le lait de bactéries du groupe «coli» qui font gonfler le fromage et dont l'action peut encore être accrue par l'emploi de méthodes peu sanitaires dans la production et la fabrication. Il faut donc choisir et employer les fourrages auxiliaires avec discernement, tant dans l'intérêt du producteur que du fromager.

Selon Peter (*27*) l'influence de l'affouragement sur la qualité du lait destiné à la fabrication de fromage est clairement établie dans quelques cas où le lait devient absolument impropre à toute fabrication de fromage. A titre d'exemple, il cite : l'affouragement d'herbe ensilée (gonflement butyrique) ou de fourrages qui provoquent une forte diarrhée chez l'animal (feuilles de betteraves, maïs vert, mélanges fourragers verts d'avoine et de vesces (A.P.V.) ou encore de fourrages provoquant de fausses fermentations (fourrages fermentés ou décomposés).

Sur ce point, nous pouvons ajouter que la diarrhée chez la vache laitière est un des plus grands facteurs de contamination du lait et qu'elle est aussi en grande relation étiologique avec la mammite, pour laquelle elle paraît augmenter beaucoup la prédisposition.

Nous allons maintenant relater quelques expériences systématiques poursuivies sur cette question:

Dans ses expériences, Savini (*20*) démontre que l'influence et l'action des fourrages ensilés sur la fabrication de quelques types de fromages crus (Crescenza et Bel Paese) d'après les expériences faites et les résultats obtenus, se résumeraient à ceci : 1. La fabrication des fromages crus à maturation rapide est négativement influencée par une alimentation en fourrages ensilés ou en betteraves fourragères. 2. Les fourrages ensilés endommagent davantage la fabrication fromagère que ne le font les betteraves fourragères. 3. L'influence, à conditions égales, est plus grande dans les fromages à longue maturation : ainsi les Bel Paese (nécessitant plus de 40 jours de maturation) sont plus influencés que les types de fromage (Crescenza) demandant 15 à 20 jours de manturation. 4. L'action se caractérise dans une première période par un retard dans l'apparition des caractères organoleptiques (odeur, saveur et arôme) et dans une seconde période par l'apparition dans les meules de véritables boursouflures, ce qui se traduit par de lourdes pertes pour les fabriques. 5. Le manque de soins sanitaires et une mauvaise application des techniques de fabrication combinés à une

alimentation défectueuse produisent très facilement des produits défectueux. De tous ces exposés, Savini conclut que dans la production d'un lait devant être transformé industriellement (en beurre ou en fromage) on ne saurait faire dominer dans la ration d'hiver des vaches laitières, les fourrages ensilés et les betteraves fourragères.

Steensberg au Congrès International de Laiterie de Copenhague de 1931 a parfaitement bien démontré l'influence défavorable des déchets de betteraves fermentés dans l'alimentation des vaches laitières.

Kursteïner (*28*) dit que les bactéries propioniques et butyriques sont la cause de gonflement des fromages. Avec Staub (*2*) il démontre que le lait provenant de vaches nourries avec des fourrages ensilés est impropre à la fabrication de l'Emmenthal de choix. Ils attribueraient ce fait à la présence des nombreuses bactéries butyriques contenues dans les fourrages ensilés.

Burri (*4*) énonce que la relation entre la fermentation butyrique des aliments et la fermentation butyrique du fromage ne fait pas de doute.

D'après les recherches de Burri et de Kursteiner (*3*) le nombre de spores de bactéries butyriques (dues aux fourrages ensilés) est très considérable, variant entre 500 à 300,000 par gramme d'excrément et qu'un grand nombre de ces spores se retrouvent dans le lait. Ils concluent également, que les chances d'obtenir des fromages ne gonflant pas (l'Emmenthal surtout), à partir de lait provenant de vaches alimentées avec des fourrages ensilés, sont très minimes. Les mêmes auteurs prétendent que, même en récoltant le lait avec des soins que l'on ne peut prendre en pratique, le lait provenant de vaches nourries avec ces aliments est impropre à la fabrication de l'Emmenthal de qualité.

Selon Gorini (*5*) l'ensilage de maïs préparé selon la méthode américaine garantit plus que tout autre une fermentation lactique prédominante, sans fermentation butyrique et l'auteur semble déduire qu'il n'y a aucune incompatibilité entre l'emploi de l'ensilage bien préparé et la fabrication du fromage Emmenthal. Néanmoins, il dit qu'il faut prendre en considération le fait que les ensilages ne sont pas toujours régulièrement parfaits et qu'ils favorisent l'infection nuisible du lait et l'apparition de fermentations gazeuses et de mauvaises saveurs. Sur ce point, nous pouvons ajouter qu'il serait très intéressant et utile de constater l'influence réelle de l'ensilage, tel que préparé dans la province de Québec, sur le fromage Cheddar et si possible, sur quelques autres types de fromages. Nous avons commencé des essais sur cette question afin de connaître l'influence de l'ensilage sur la fabrication et la conservation d'un type de fromage Bel Paese, qui sera fabriqué à Henryville par la Coopérative Fédérée de Québec.

Les analyses de lait que nous avons faites depuis quelques années en différentes régions de la province, nous ont donné, dans une proportion considérable, des résultats indiquant la plus ou moins grande valeur industrielle des laits examinés. Les cas de fermentations anormales (coli, aerogenes, butyriques, caséolytiques) étaient très nombreux.

Avec des laits d'une telle qualité, il serait presque impossible de vouloir réaliser la fabrication d'autres types de fromage que le Cheddar. Egalement, la fabrication de fromages affinés à pâte molle et semi-dure (Camembert, Brie, Bel Paese, Roquefort, Stilton) et de fromages frais

à pâte molle et même ceux du type Gruyère, serait pratiquement impossible sans la pasteurisation du lait. Par cette dernière, on détruira la plupart des bactéries indésirables, mais il faudra toujours compter sur les fermentations butyriques. C'est pour cette raison que nous attirons l'attention des experts canadiens sur la nécessité de modifier quelques pratiques courantes d'alimentation.

Toutes les expériences précitées tendent surtout à démontrer l'importance des fermentations anormales des aliments sur la qualité des produits laitiers. Nous devons accorder une attention toute particulière à la fermentation butyrique, laquelle est presque toujours constatée dans les produits ensilés, etc. . .

En plus de causer des torts considérables dans presque toutes les industries agricoles, les bactéries butyriques affectent tout particulièrement l'industrie du lait. L'action nuisible de ces bactéries est attribuable à l'odeur repoussante de l'acide butyrique produit et à la difficulté de détruire ces bactéries une fois introduite dans le lait. Toutes ces bactéries portent des spores et c'est à cela qu'elles doivent leurs grande résistance à la chaleur : (elles résistent à la pasteurisation à 63°C pendant 30 minutes, de plus leurs spores résistent même à la stérilisation ordinaire). Ces propriétés thermo-résistantes nous font voir que la valeur de la pasteurisation est plutôt limitée lorsqu'il s'agit d'éviter leur action sur le beurre et les fromages.

Si nous considérons l'apport considérable de ces bactéries de fermentations anormales dans le lait, il nous faut aussi considérer que les aliments mal conservés et surtout les ensilages sont les agents essentiels de cette introduction. En conséquence, il serait à recommander que les mesures préconisant le rejet de l'ensilage ou son amélioration par différents procédés (le but de ces méthodes est de supprimer les fermentations indésirables) soient étudiées également dans la province de Québec.

Cela ne veut pas dire que l'ensilage est un aliment destiné à disparaître de l'alimentation des vaches; depuis une quinzaine d'années, il s'est fait beaucoup de travail pour arriver à produire un ensilage hygiénique et pouvant convenir sans danger aux utilisations industrielles du lait.

Le principe de quelques méthodes d'amélioration des ensilages est le suivant: par des solutions acides (acides sulfurique, chlorhydrique dilués, lait écremé ou petit-lait acidifié par des ferments lactiques) on abaisse le pH de l'ensilage à un point tel que les microorganismes indésirables ne se développent plus. Cet abaissement du pH *ayant pour but la production d'une fermentation lactique prédominante dans le produit.*

Ainsi, la méthode d'ensilage lactique, préconisée en Allemagne et en Italie et adaptée en France, consiste dans l'arrosage des couches d'ensilage, lors du remplissage, avec une quantité déterminée de lait écremé acidifié par des ferments lactiques. Par contre, dans la méthode Virtanem (ensilage A.I.V.) décrite dans la "Revue du Lait" 13 : 315-339-1933 et dans le "Journal of Dairy Science", p. 63, janvier 1935, l'abaissement du pH est tel qu'il empêche toute action enzymatique ou bactérienne dans le produit.

Plusieurs instituts d'Europe s'occupent de la distribution de ces cultures et il semble qu'avant longtemps cette mesure sera rendue obligatoire en France, si on en juge par les vœux émis par le Conseil Supérieur d'Hygiène de France.

D'après les expériences faites, ces ensilages n'auraient pas de mauvaises influences sur la qualité des produits laitiers et en plus, les principes nutritifs de ces produits seraient conservés pratiquement intacts. Ceci serait déjà un avantage appréciable, car tout le monde connaît les pertes importantes d'éléments nutritifs subies au cours de la préparation ordinaire de l'ensilage.

Toutes ces considérations militeraient en faveur d'expériences canadiennes sur ces méthodes d'amélioration de la qualité des ensilages et permettraient en même temps la suppression d'une des causes les plus sérieuses d'altérations du beurre et des fromages.

Voici maintenant comment ont été appliquées dans la pratique les conclusions de tous ces travaux de recherches et d'expérimentation. A cet effet, nous allons reproduire textuellement quelques articles du règlement suisse de production laitière. Nous soulignons tous les articles pouvant concerner nos pratiques actuelles d'alimentation des vaches laitières.

Tous les articles qui vont suivre (*22*) sont obligatoires pour tous les producteurs et les entreprises qui livrent du lait et des produits laitiers au commerce en Suisse.

RÈGLEMENT SUISSE DE PRODUCTION LAITIÈRE. 1er juin 1934

1. Traitement des fourrages et affouragement

A. Le régime vert.

Article 7. *Le régime vert sera appliqué de façon à éviter les troubles digestifs qui, accompagnés d'une plus ou moins forte diarrhée, compromettent non seulement la qualité du lait, mais aussi dans une forte mesure le rendement économique et les fonctions de reproduction des vaches laitières.*

Article 9. Le meilleur fourrage vert pendant la stabulation est une bonne herbe (ni trop jeune ni trop vieille) provenant de bonnes prairies naturelles, de champs de trèfle ou d'autres prairies artificielles bien cultivées et bien fumées. Eviter tout régime unilatéral, spécialement l'emploi exclusif de jeune trèfle, d'herbe de vergers ou de prairies trop intensivement arrosées au purin. On préviendra les dangereuses perturbations de fabrication en donnant aux vaches laitières des mélanges appropriés de différents fourrages verts.

Le seigle, *le maïs et l'avoine verts, les vesces*, le colza, la spergule, les feuilles de betteraves (fourragères et sucrières) et de choux-raves (navets) ne doivent être donnés qu'à l'état absolument frais, en quantités modérées et seulement en mélange avec de l'herbe fraîchenent fauchée ou du fourrage sec.

Article 10. Sont autorisés comme compléments du fourrage vert:

(*a*) du fourrage sec. Il est toujours recommandable de donner du foin avec l'herbe très mouillée ou qui peut provoquer la diarrhée.

(*b*) Quant le temps est froid et pluvieux : un peu de bon gros son de blé (éventuellement avec le sel nécessaire) donné sec, dans la crèche ou à la main.

Article 11. Il est interdit de donner pendant le régime vert, tout fourrage qui n'est pas mentionné aux articles 9 et 10.

En temps de pénurie de fourrages verts appropriés, l'acheteur de lait et le producteur s'entendront pour compléter éventuellement la ration avec des céréales concassées, du son etc. . .

ARTICLE 12. Sont spécialement exclus de l'affouragenent des vaches laitières.

(*a*) l'herbe arrosée au purin, dont la croissance est trop avancée, ou sur laquelle *on a épandu des engrais chimiques après le départ de la végétation.*

(*b*) *l'herbe qui fermente* (échauffée)

(*c*) *l'herbe en voie de décomposition à la suite de pluies persistantes.*

(*d*) les déchets de jardinage de toute sorte, les *pommes de terre et leurs tiges*, les fruits et leurs résidus.

(*e*) le *foin* ou le *regain en fermentation.*

B. LE RÉGIME SEC.

ARTICLE 14. En choisissant les fourrages, on tiendra compte tout d'abord de leur composition. Ils doivent être sains, exempts de substances toxiques ou nuisibles à la santé. Sont particulièrement dangereux les *fourrages rancis, moisis, acides, attaqués par des parasites animaux ou végétaux ou détériorés par la fermentation.*

ARTICLE 15. La base de la ration sera composée de foin et de regain sain ayant normalement fermenté, exempts de moisissures; exceptionnellement de bonne paille.

On ne donnera pas de *foin ou de regain bruni ou moisi* aux vaches laitières. Entrent en ligne de compte comme fourrages complémentaires:

(*a*) la balle de céréales.

(*b*) les betteraves fourragères et demi-sucrières, les carottes et les choux-raves en quantités modérées.

(*c*) les pommes de terres saines, fraîchement cuites à la vapeur, puis refroidies et données entières.

ARTICLE 16. On ne pourra compléter la ration de foin, de regain ou de paille qu'avec des fourrages concentrés sains, digestibles, bien préparés et en mélange judicieux. Sont admis à ce titre:

(*a*) les grains de céréales sains, fraîchement concassés, comme l'orge, l'épeautre, l'avoine, le blé et le son de blé.

Le seigle et la farine fourragère fraîche ne peuvent être employés qu'en petites quantités et seulement d'entente avec l'acheteur de lait, lorsqu'il s'agit de lait de fromagerie.

(*b*) *les tourteaux oléagineux frais* (lin, arachide) en quantité ne dépassant pas ½ kg par tête et par jour pour la moyenne du troupeau. *En aucun cas, la ration de tourteaux d'une seule vache ne doit dépasser 1 kg.*

(*c*) les germes d'orge, le malt desséché, les *cossettes de betteraves desséchées*, mélangées avec d'autres concentrés. La ration de chacun de ces fourrages ne dépassera pas ½ kg par vache et par jour.

La ration totale de tous les fourrages concentrés ne doit pas dépasser 1½ kg. par vache et par jour.

Les tourteaux ne doivent jamais être donnés seuls, mais en mélange avec du grain concassé ou du son de blé.

Normalement, on ne donnera pas plus de 30 grammes de sel (1 once environ) par vache et par jour.

ARTICLE 17. *Il ne faut en aucun cas mouiller les fourrages concentrés* ou les donner sous forme de *breuvage* (*barbotages*). On les conservera dans des locaux frais, secs et aérés. Les récipients servant à l'affouragement des concentrés ne doivent pas être laissés à l'étable.

C. DISPOSITIONS COMMUNES AUX DEUX RÉGIMES (VERT ET SEC).

ARTICLE 18. Les fourrages suivants sont interdits:

(*a*) *les fourrages ensilés de toute sorte* (ensilage doux, de maïs, de feuilles de betteraves, etc.

(*b*) *les pommes de terre crues* et les *racines de toute sorte en voie de décomposition.*

(*c*) les *cossettes de betteraves fraîches ou desséchées et longtemps trempées,* les *fourrages mélassés de toute sorte,* les *germes d'orge longtemps trempés,* les *tourteaux trempés,* le malt frais, la levure de bière, les résidus de la distillation des pommes de terre (vinasses) et de la fabrication des levures.

(*d*) les fruits, les marcs et les déchets de fruits de toute sorte.

(*e*) les fourrages mélangés du commerce de composition inconnue.

(*f*) tous les autres fourrages qui ne sont pas autorisés d'après les articles précédents.

ARTICLE 19. La division de l'agriculture du Département fédéral de l'économie publique peut autoriser des exceptions temporaires aux dispositions de l'article 18, dans le cas de pénurie de certains aliments et sur l'avis des autorités compétentes.

2. Fumures des terres destinées à la culture fourragère

ARTICLE 2. On appliquera le fumier et les engrais chimiques nécessaires à la culture des prairies artificielles (plantes annuelles, trèfles, mélanges etc.) autant que possible à la récolte précédente, c'est-à-dire qu'on les enfouira en ensemençant.

ARTICLE 3. On épandra les engrais chimiques sous quelque forme que ce soit exclusivement pendant le repos de la végétation, c'est-à-dire depuis l'arrière-automne jusqu'au commencement du printemps.

ARTICLE 4. On restreindra autant que possible l'emploi du purin, que l'on répartira sur toutes les prairies, afin d'éviter la croissance de fourrages médiocres (herbe forcée ou envahie de mauvaises herbes).

Il est interdit d'épandre le purin sur de l'herbe dont la végétation est trop avancée. Le purin doit être fortement dilué avec de l'eau. Il est interdit d'ajouter quoi que ce soit au purin pour le conserver, sauf de l'eau.

Autres dispositions du règlement suisse

Dans l'article 20, on dit : Il est interdit de loger des porcs et des poules dans les étables de vaches laitières, à moins de les séparer suffisamment. Dans l'article 21, on dit : Eviter la litière verte de toute sorte, telles que l'herbe, les tiges de pommes de terre etc. . .La litière de tourbe n'est permise que comme absorbant du purin. Les matériaux à faible pouvoir absorbant seront mélangés à la litière.

Pendant la traite, il est interdit de sortir le fumier, de faire la litière, de panser les animaux ou d'exécuter tout travail qui soulève de la poussière.

Dans l'article 28, on dit : Sont particulièrement exclus de la livraison et de l'alimentation.

(*a*) le lait qui forme des grumeaux à la cuisson ou au repos, révélant généralement une maladie du pis.

(*d*) le lait de vaches atteintes de maladies graves ou auxquelles on administre des médicaments et ce, pendant les 4 jours qui suivent leur dernier emploi.

(*e*) le lait de vaches partiellement taries que l'on ne trait plus qu'une fois par jour.

(*h*) le lait qui présente des défauts graves de coagulation à l'essai de présure.

Pour plus de détails, référer au règlement suisse de production laitière, lequel est distribué par l'Imprimerie Fédérative, S.A. de Berne, Suisse.

Ce qui nous frappe dans la lecture de ce règlement, c'est l'énorme travail réalisé et l'ensemble de précautions que l'on apporte en Suisse à la production laitière.

CONCLUSIONS

L'objet de cet article est d'attirer l'attention des techniciens canadiens sur cette importante question de l'alimentation des vaches laitières.

Notre désir serait que l'on étudie et applique en notre pays, les pratiques qui semblent donner de si bons résultats en Europe. Notre but n'est pas de préconiser un changement complet des systèmes d'alimentation des vaches laitières, mais de souligner seulement les modifications pouvant être apportées.

Nous comprenons que ces changements ne peuvent s'opérer du jour au lendemain; ils exigent plusieurs années d'études et de recherches avant d'être appliqués dans la pratique. L'expérience a démontré que l'introduction de fromage dans un pays autre que celui d'origine, demande comme une des considérations les plus importantes, l'adaptation de l'alimentation des vaches laitières. Par exemple, l'introduction du Gruyère en France par la maison Maggi de Paris, ne fut rendue possible qu'après 7 à 8 années d'essais en vue de déterminer les aliments à utiliser. Il en fut de même pour l'introduction du Bel Paese en Allemagne. Ce manque d'adaptation des conditions particulières de fabrication a été une des causes principales de maints échecs en Amérique lorsqu'il s'est agi d'introduire des types de fromages bien réputés en Europe.

En mettant à profit l'expérience acquise dans les pays européens, nous pourrions réaliser plus rapidement la fabrication de leurs produits en notre pays.

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Résumé

Observations on the Influence of Feeding in the Production of Milk of a Good Commercial Quality. H. L. Bérard, Jules Turgeon and J. M. Roselle, Dairy School, St-Hyacinthe, P.Q.

The object of this article is to call the attention of Canadian technical agriculturists to the important question of feeding milch-cows.

There are methods of feeding practised in Europe which appear to give very good results there, and it is believed that a study of these methods, with a view to applying the same to our country, would be desirable. This would not necessitate a complete change in our feeding practices, but merely improving the same.

It is realized of course that such changes could not be made at a day's notice; several years of study and research would be necessary before they could be applied. Experience has shown that adaptation of feeding methods is the most important consideration when introducing the making of foreign cheese in any country. For instance, the introduction of Gruyère cheese in France by the Maggi firm of Paris, required seven or eight years of experiments in order to ascertain the most suitable feeds. The same occurred when Bel Paese cheese was introduced in Germany. This lack of adaptation of feeding methods in cheese making has been one of the main causes of the many failures that were recorded in America when attempts were made to introduce the making of European cheese.

Success in the making of European cheese in Canada could be achieved far more quickly by studying the experience gained in the country of origin.